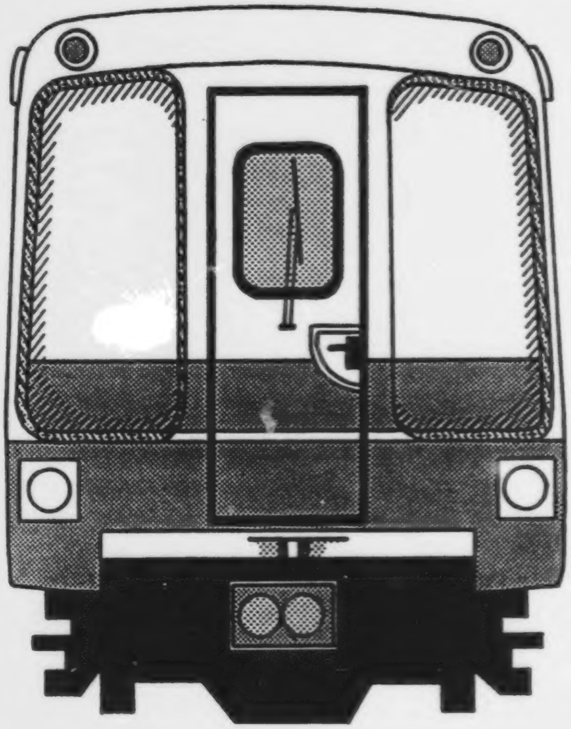
ALRT Impact Assessment
Baseline Travel Survey



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Prepared for:
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Transport Canada

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ALRT IMPACT ASSESSMENT

BASELINE TRAVEL SURVEY

FINAL REPORT

by

D. Peterson
Greater Vancouver Regional District

and

R. Glover
BC Transit

December 1987

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17. Résumé

Le système SkyTrain fonctionne dans la région de Vancouver depuis janvier 1986. Comme il représente un changement majeur en fait de niveau de service, il bouleversera sans doute les habitudes de transport connues jusqu'ici. Il a été estimé utile, sur le plan de la planification des systèmes de transport légers sur rail tant à Vancouver que partout au Canada, de vérifier l'impact du SkyTrain sur la distribution des déplacements privés et collectifs.

Ce rapport rend compte de l'enquête faite entre septembre et novembre 1985 pour déterminer les habitudes de déplacement dans la région de Vancouver avant la mise en service du SkyTrain, dans le cadre d'une Etude sur l'impact des systèmes de transport légers de type avancé. Les éléments de cette recherche ont été les suivants: sondage auprès de plus de 25 000 foyers, un carnet des déplacements remis à quelque 1 700 ménages, des comptages de la circulation, une enquête cordon, une enquête taxi, une enquête sur les déplacements pour travail ou affaires et enfin une auprès des clients du SkyTrain et un comptage des places de stationnement à proximité des stations SkyTrain.

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17 Abstract

SkyTrain has been operating in the Vancouver region since January, 1986. As SkyTrain represents a major change in transportation service levels in the region, it is expected that travel patterns will undergo significant change over time. Determining the impact of SkyTrain on the distribution of automobile and transit trips would have a practical application in the future planning of rail transit projects in Vancouver and Canada as a whole.

The Advanced Light Rapid Transit (ALRT) Impact Assessment Baseline Travel Survey was undertaken from September to November 1985 to provide a description of travel patterns in the Vancouver region prior to SkyTrain. The project components included a home interview survey of over 25,000 households, a trip diary administered to approximately 1,700 households, traffic screenline counts, an external cordon survey, a taxi survey, a survey of trips for work or business purposes, a survey of SkyTrain riders and an inventory of parking near SkyTrain stations.

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1. INTRODUCTION

1.1 The SkyTrain System

In January 1986, SkyTrain began revenue service to serve travel demand in one of the area's most heavily-used corridors and bring visitors to and from the site of Expo 86. The SkyTrain system was intended to be a demonstration of the finest in Canadian advanced light rapid transit (ALRT) technology.

As the backbone of the transit system in the Vancouver area, the 21.4 km SkyTrain Phase I line (Figure 1) connects downtown Vancouver with the suburban municipalities of Burnaby and New Westminster. The lightweight, linear-induction-powered vehicles operate on a primarily elevated guideway with some at grade sections and a tunnel section in downtown Vancouver. The system is fully integrated with bus services and most of the fifteen stations on the line have adjacent bus loop and auto drop-off facilities.

SkyTrain is a fully automated system with driverless trains. Service operates for approximately 19 hours a day using two to four car trains at frequencies of 3-5 minutes. During the Expo 86 world's fair, SkyTrain carried up to 120,000 passengers daily but post-Expo ridership has stabilized at approximately 55,000 per weekday.

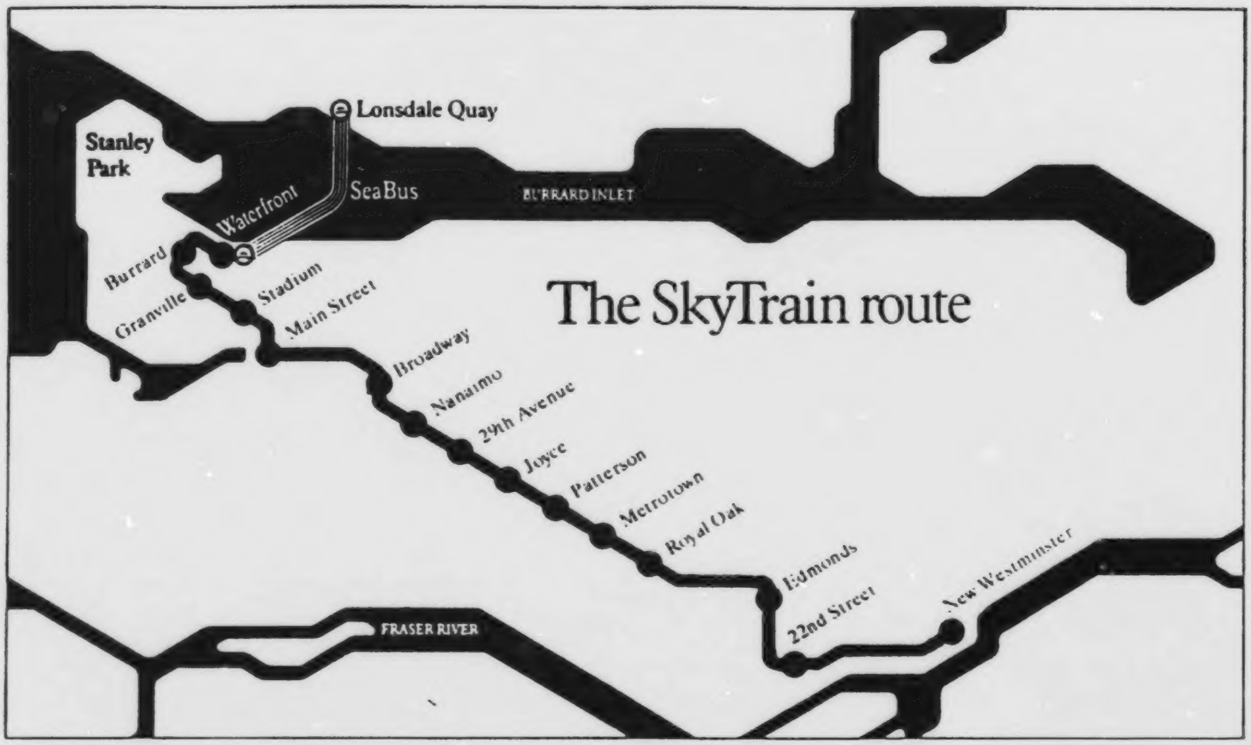
1.2 The Requirement for an Assessment of SkyTrain's Impact

In Vancouver the lack of reliable information on urban travel in the metropolitan area has been of considerable concern to various transportation agencies including BC Transit and the Greater Vancouver Regional District (GVRD) and its member municipalities. Effective planning and funding decisions for urban transportation systems require reliable data on where people are coming from, where people are going to, how they are getting there and when they travel.

Over the past decades, transportation planning in Vancouver was based on information obtained from numerous ad-hoc studies undertaken by a multiplicity of provincial, regional and municipal transportation agencies. These studies included a 1972 regional travel survey of questionable validity, an outdated 1976 on-board transit survey, numerous operations and parking surveys and various traffic counts and transit load checks. In total, the studies addressed individual research problems but did not provide a comprehensive and commonly accepted data base for the analysis of urban travel.

The impetus to undertake a comprehensive survey of travel in the Vancouver region was the development of SkyTrain. In view of the extensive involvement of government in the planning and implementation of SkyTrain, both Transport Canada and BC Transit wished to undertake an

Figure 1
SkyTrain Route


The SkyTrain route
Stanley Park
Lonsdale Quay
SeaBus
Waterfront
BURRARD INLET
Burrard
Granville
Stadium
Main Street
Broadway
Nanaimo
29th Avenue
Joyce
Patterson
Metrotown
Royal Oak
Edmonds
22nd Street
New Westminster
FRASER RIVER

assessment of SkyTrain's impact on the Vancouver region. The impact assessment would require a comprehensive description of "baseline" travel patterns prior to the introduction of SkyTrain.

To meet both objectives, Transport Canada, BC Transit and the Greater Vancouver Regional District (GVRD) jointly undertook to organize and fund a comprehensive travel survey within the Vancouver Census Metropolitan area (Figure 2).

1.3 Travel Baseline

The impact of SkyTrain on travel characteristics in the Vancouver region was the central focus of the ALRT Impact Assessment. As a major transportation improvement, SkyTrain could be expected to have a considerable impact on travel in the following areas:

(a) travel desires - A major research question is the extent to which SkyTrain can be expected to alter the overall distribution of travel in the region. The impact of SkyTrain on travel patterns can be determined by a comparison of trip patterns before and some years after the introduction of SkyTrain.

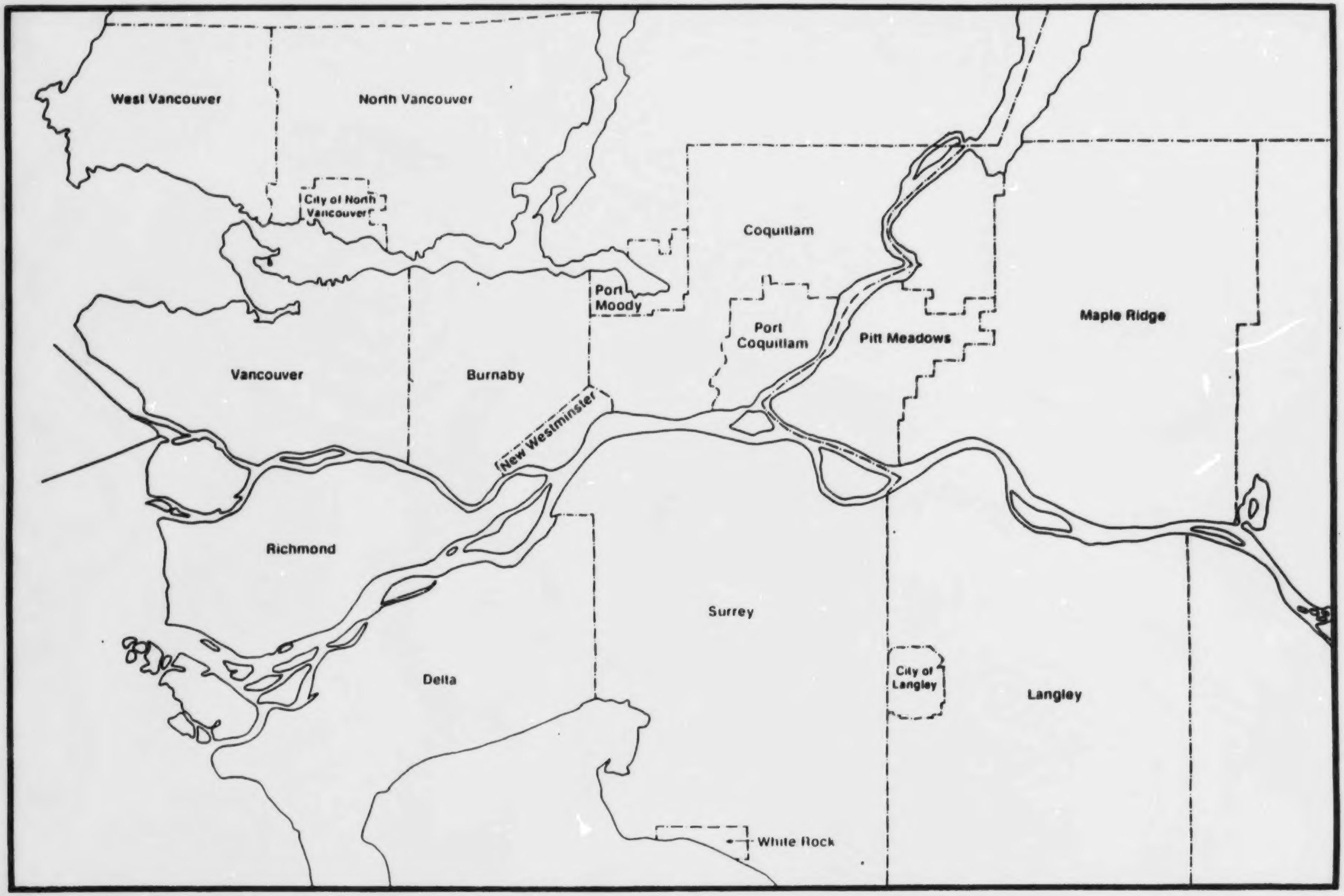
(b) travel demand - SkyTrain can also be expected to exert some impact on private vehicle travel in the region. Screenline counts and mode split analysis can identify these impacts.

(c) transit ridership - This impact area focuses on the effect of SkyTrain on transit system ridership levels including system wide ridership, corridor ridership and mode split. Base data for this analysis includes the results of the telephone interview survey and screenline counts. It is also anticipated that SkyTrain could appeal to social groups different than those usually served by the transit system. The introduction of SkyTrain may therefore alter the transit ridership profile in terms of age, sex, trip purpose, etc. These impacts will be derived from the telephone interview survey and a survey of SkyTrain riders.

(d) parking activity - Private vehicle access to SkyTrain has on occasion surfaced as an issue for users of the system. The extent of park-ride demand for SkyTrain and the characteristics of park-ride activity in the vicinity of stations will be addressed through a rider survey of SkyTrain and an inventory of parking activity near stations prior to SkyTrain service.

The following outlines the major projects undertaken to collect data for the pre-SkyTrain travel baseline.

Figure 2
Vancouver Census Metropolitan Area


West Vancouver
North Vancouver
City of North Vancouver
Coquitlam
Port Moody
Port Coquitlam
Pitt Meadows
Maple Ridge
Vancouver
Burnaby
New Westminster
Richmond
Surrey
City of Langley
Langley
Delta
White Rock

1.4 Impact Assessment Components

1.4.1 Metropolitan Vancouver Origin-Destination Survey

The Metropolitan Vancouver Origin-Destination Survey was undertaken in the Fall of 1985 from September to December and included the following components:

(a) home interview survey - approximately 25,000 households provided travel data by means of a telephone interview.

(b) trip diary - approximately 1700 households completed a detailed three-day diary of all trips taken by each member;

(c) taxi survey - a single-day survey of taxi trips;

(d) survey of travel for work and business purposes;

(e) external cordon survey - a survey of trips into and out of the metropolitan area at major entry/exit points;

(f) screenline counts - vehicle counts and transit load counts at locations throughout the region.

1.4.2 SkyTrain Rider Survey

A survey of SkyTrain riders was undertaken during the week of March 23-27, 1987. The objectives of the SkyTrain Rider Survey are summarized as follows:

(a) to identify the travel patterns of SkyTrain riders in terms of origins, destinations, access mode, walking distance and usage frequency.

(b) to determine the impact of SkyTrain on travel behaviour. Respondents were surveyed concerning their mode prior to SkyTrain, car availability, impact on rider's residential location and shopping habits.

(c) to solicit public attitudes towards SkyTrain generally and also specifically in the areas of reliability, speed, noise, safety, transferring, ticket vending machine use, etc.

Questionnaires were distributed at stations to all inbound (westbound) riders from the start of service to the end of service.

1.4.3 SkyTrain Parking Inventory

A baseline parking inventory was undertaken in November and December, 1985 immediately prior to the start of revenue service on SkyTrain. The purpose of the inventory was to provide information on parking availability and utilization within SkyTrain station areas as a basis for followup surveys.

1.5 Organization of this Report

1.5.1 Audiences

This report has been written with two audiences in mind.

The first group is the local clients and sponsors of the survey, for whom the report documents how the survey was conducted and managed and how the various results were obtained. For this group, the presentation of detailed results is of lesser importance given that various reports and tabulations are already in their hands. This group also has direct and easy access to the data bases in order to generate the specific results they may require.

The second audience is the wider community of transportation planners across Canada and elsewhere. This may include people who are contemplating conducting travel surveys and who might therefore benefit from the experiences in Greater Vancouver. This group also includes people who may be seeking to compare specific indices - modal splits, generation rates, travel composition, etc. - in their area with those of Greater Vancouver. (Since the data bases are public domain, people in this group can also obtain more specific and detailed results.) This report attempts to anticipate the results that this group would most commonly find to be useful. It also attempts to provide sufficient insight into the derivation of these results.

1.5.2 Following Sections

Section 2, "Project Initiation" describes the process by which the ALRT Impact Assessment project was conceived and funded.

Section 3 describes the telephone interview survey component of the Metropolitan Vancouver Origin-Destination Survey. It describes the design and execution of the survey and presents some of the results.

Section 4 describes the trip diary component of the O-D Survey. Comparisons between the trip diary results and the telephone survey results are also presented in this section.

Section 5 describes the external cordon surveys conducted as part of the O-D Survey. These surveys measured travel into, and out of the survey area.

Section 6 describes the process by which various screenline (ie. cordon) counts consisting of vehicle volumes and occupancy, vehicle classification and transit ridership, were conducted concurrent with the O-D Survey.

Section 7 describes the attempt to measure travel within the survey area for work or business purposes. This survey - intended to be in lieu of a truck survey or commercial travel survey - was not successful in measuring O-D patterns and generations but did provide some useful profiles of commercial travel.

Section 8 describes the survey to measure taxi travel.

Section 9 describes the SkyTrain Rider Survey conducted by BC Transit to determine the personal characteristics, travel characteristics and attitudes of SkyTrain riders.

Section 10 describes the Parking Inventory Survey conducted by BC Transit to provide baseline data on park-ride activity in station areas.

Section 11 presents the approach to measuring the impact of SkyTrain over time, for which the above survey components will provide baseline data.

In Section 12, some of the more broadly-useful findings of the survey exercise are summarized, particularly those of potential benefit to agencies in other areas considering undertaking a comprehensive travel survey.

Appendix A outlines the deliberations of the Transit Technical Committee subcommittee on data needs which first identified the need for a comprehensive travel survey.

Appendix B provides a bibliography of reports and studies that proved to be useful in the original design of the O-D Survey.

Appendix C presents survey or questionnaire forms and coding instructions used in each of the components of the O-D Survey and BC Transit's SkyTrain Rider Survey.

Appendix D describes the data base structures which contain the results of the O-D Survey components.

Appendix E presents some detailed results from the SkyTrain Rider Survey and SkyTrain Parking Inventory.

Appendix F presents an outline of the automated procedures implemented in conjunction with the telephone interview survey. Considerations germane to the choice between automated versus "on-paper" data entry and geo-coding procedures are discussed.

2. PROJECT INITIATION

2.1 First Steps

2.1.1 1983 GVRD Workshop

When transportation planning officials met in July, 1983 at a "Workshop on Transportation Investment Choices for Greater Vancouver", one point of consensus was that reliable data was required as a foundation upon which all parties could build their analyses of current and future transportation requirements. Furthermore, it was estimated that, in total, municipalities and other agencies reponsible for various aspects of urban transport would be spending upwards of $500,000 over the coming three years for data collection without achieving a comprehensive and commonly useful product.

2.1.2 BC Transit On-Board Survey

BC Transit was one agency that had been considering an independent data collection exercise. In 1983, BC Transit had assessed the need for an on-board survey of transit riders to obtain current information for service planning and marketing. Early on, they rejected this option in favour of a larger, multi-modal origin-destination survey.

It was concluded that a comprehensive survey of trips by all modes in the region could be more useful and cost-effective than an updated on-board transit survey. On-board surveys produce O-D patterns that are dependent on the transit route structure; also, on-board surveys do not provide data on non-transit trips which, in Greater Vancouver, are about 90% of vehicle-based trips. A comprehensive travel survey would provide a broader data base of both transit and non-transit trips for transit planning and marketing. As the costs of a travel survey were approximately two to three times those of on on-board survey, however, it would be necessary to organize a broader base of financial support amongst municipalities in Greater Vancouver. To this end, in November 1983, BC Transit brought forward a proposal to the Transit Technical Committee (TTC), a group of provincial and municipal staff advising the Vancouver Regional Transit Commission on transit matters[1].

2.1.3 ALRT Impact Assessment

Concurrently in late 1983, BC Transit commissioned McLaren Plansearch to develop terms of reference for a comprehensive impact assessment of ALRT[2]. The study design published in April 1984 proposed a longitudinal study to be carried out over a ten year period from 1985 to 1995. A broad range of impact areas would be covered including planning and construction, noise, travel, direct and indirect local effects, urban development, economic and social impacts. Baseline studies were to be undertaken in 1984 and 1985 with followup studies carried out at two year intervals beginning in 1986. The cost estimate for the baseline studies was $990,000.

2.1.4 Transit Technical Committee Consideration

Acting on the proposal by BC Transit, the TTC delegated a sub-committee to examine data needs and approaches to obtaining a comprehensive data base on regional travel. Discussions throughout the first half of 1984 established substantial agreement amongst the participants on the necessity for a regional travel survey to address a variety of data needs including:

(i) Municipal Traffic Planning

Municipalities are faced with a variety of transportation problems, including problems occurring outside of normal peak travel periods or unrelated to the work trip. Data was required on off-peak, non-work and non-downtown destined trips. Downtown mid-day traffic congestion and shopping trips at retail centres were other issues for which reliable data was not available.

(ii) Transportation Modelling

The GVRD was preparing to install the EMME-2 transportation model developed by the University of Montreal. Calibration of the model to observed trip patterns required a variety of data inputs including demographic data, screenline counts and observed trip tables. Initially, the model was calibrated to a 1981 AM peak period trip table derived from the 1981 Census residence - place of work data. Ultimately, however, a more reliable process based on observed trip tables for a wider variety of travel times and purposes was required.

(iii) SkyTrain Impact Assessment

It was recognized that over time, travel patterns would undergo substantial change as major transportation projects such as SkyTrain and the Alex Fraser Bridge alter the distribution of auto and transit trips in the region. Determining the precise impact of these projects would be useful as a basis for future planning of rail transit and major road projects. It would be necessary, therefore, to ascertain travel patterns before and after implementation of these projects. A comprehensive travel survey conducted prior to revenue service would provide a description of baseline conditions.

(iv) Transit Service Planning

Transit planning requires precise travel data to ensure that route design conforms to current travel desires. On-board transit surveys provide information on how riders are using the existing transit service, but they do not survey the travel desires of the approximately 90% of all daily trips which are not made by transit. Without the information available from an O-D survey, service planning decisions might not reflect the majority of travel needs in the Vancouver region, thus potentially reducing the marketability of transit.

(v) Transit Marketing

Development of a marketing plan for transit services would require basic behavioural data (walking distance, etc.) of transit users. An on-board transit survey could be used to obtain this data, but a region-wide all-mode approach allows the surveying of the broader sample of non-transit users.

These diverse needs appeared to require a comprehensive travel survey of a full day of regional travel by all modes.

Appendix A provides a summary of the discussions of the TTC Subcommittee. The subcommittee confirmed that a home-based survey using the telephone interview method was most preferable as the principal O-D survey instrument. (Employer-based surveys are restricted to work-based travel and have the difficulty of identifying and sampling from the population of employers. Trip-based surveys - using roadside interviews at cordon points, on-board transit surveys and employing sparse matrix analysis methods - were felt to be too limited in terms of the scope of the data that could be collected and because roadside interviews could only be conducted in daylight hours.) The subcommittee deferred further work pending the determination by GVRD of the extent of participation in the project by other bodies - including provincial and federal agencies and other non-GVRD communities or regional districts in the Lower Mainland - and the related funding arrangements.

2.2 Preparation of a Work Plan and Survey Design

To expedite the process, the GVRD commissioned Dr. Gerald Steuart of the University of Toronto to identify a cost-effective method of carrying out a comprehensive travel survey, and to prepare a preliminary work plan. The "feasibility study" outlined the components of a survey having the objective: "to obtain data from a sample of all trips on the road and transit systems in the metropolitan Vancouver area during normal working days and for a representative time period."[3] Figure 3 summarizes Dr. Steuart's proposals as to what each of the six survey elements should encompass and Appendix B provides a bibliography from Dr. Steuart's report. Other features of Dr. Steuart's examination included:

(a) The experience of the Montreal Urban Community Transit Commission (MUCTC) provided guidelines and performance measures which helped in the design and estimation of costs of the telephone survey. The MUCTC has conducted four large-scale O-D surveys since 1970.

Figure 3

"FEASIBILITY STUDY" PROPOSALS FOR THE COMPONENTS, SCOPE AND FORMAT OF A COMPREHENSIVE URBAN TRAVEL SURVEY

Objective: To obtain a representative sample of all trips on the road and transit system during normal working days for a representative time period.

1. Telephone Interviews

- 24-hour survey of person travel
- sample from residential telephone directory
- target sample size of 6% of GVRD households
- extensive automation for survey monitoring and management, data entry and editing and geo-coding

2. Trip Diary

- for trip generation, modal split analysis, to identify bias and underreporting in telephone survey
- to provide a data for choice-based estimations and for cross-classification and category analysis
- to measure within-household and day-of-week variations
- target of 2500 completions of 5-day trip diaries

3. Truck Survey

- self-administered diary
- to describe trips and loads
- 16% sample to be drawn from insurance or registration records
- pilot study to establish proportion of trucks registered in Vancouver but operating elsewhere

4. Taxi Survey

- 25% sample of taxi fleet, data from trip sheets

5. External Cordon Survey

- by means of mail-back questionnaire to all entering vehicles
- driver to record all trips in subsequent 24 hours

6. Screenline Counts

- to confirm validity of surveyed patterns and to identify variations in flows during survey period
- 24-hour axle counts plus simultaneous classification and occupancy counts

7. Promotion and Public Awareness Campaign

(b) In the Montreal surveys, the traffic zone within which each trip end lies is recorded. In its three subsequent surveys, the MUCTC has been somewhat constrained to use the zone system it first used in 1970. Greater Vancouver has a traffic zone system based on census tracts.

It was suggested that, by first identifying the Universal Transverse Mercator (UTM) coordinates of trip ends and then locating these trip ends within traffic zones, later reaggregations of the collected data would be feasible. For example, subsequent re-definitions of the traffic zone system could be accommodated, trip data within various offsets from travel corridors or transit routes could be summoned, or data elements from the O-D survey could be compared with similar data derived from other surveys using a different zonal system.

(c) An automated geo-coding process was proposed by the feasibility study making use of Statistics Canada's Area Master File. With the AMF, specified addresses could immediately and automatically be assigned the UTM coordinate of the appropriate block face. The AMF was to be augmented by a file of the UTM's of some of the region's major landmarks or "monuments", and by a file of the UTM's of major intersections.

(d) As well as automated geo-coding, the feasibility study anticipated extensive use of computerized processes in the telephone survey. These included the preparation of coding forms and contact letters, data entry and preliminary verification via micro-computers at the interviewers' stations, automatic notation of interview status (time, date, completion status, etc., plus "bring forwards" in cases where no contact was made or the interview was incomplete), generation of interviewer work assignments, preliminary data processing and report generation.

(e) Unless it were to be delayed until at least 1987, the travel survey would have to proceed in the period September through November, 1985. Prior to September, summer travel patterns would not be typical. Similarly, December travel patterns would be disrupted by the Christmas season. Furthermore, three events would occur in Greater Vancouver that would significantly change travel patterns. First, BC Transit's new SkyTrain system would go into revenue service. Secondly, a new bridge crossing of the Fraser River (the Alex Fraser Bridge) would be opened in 1986. Thirdly, travel patterns throughout Greater Vancouver would be disrupted in 1986 because of the EXPO 86 World's Fair.

(f) The feasibility study developed a 9-month survey design and execution program. A start at the first of April could lead to the "kick off" of the telephone interviews in early September, with other activities phased in parallel.

(g) The cost of the entire survey as proposed was estimated at $700,000, requiring five full time technical supervisors in addition to field and clerical staff.

2.3 Securing Necessary Funding

While the feasibility study was being prepared, GVRD Development Services and BC Transit were attempting to secure participation in and funding for the survey. In anticipation of a "go" and with the approval of its member municipalities, the Department had allocated $205,000 for the survey project in 1985.(1)

Approval of federal funding for the ALRT Impact Assessment in early 1985 ensured BC Transit's participation in the amount of $280,000, cost shared 50% by Transport Canada. Thus, there was a total allocation of $485,000 for the project.

With a total cost for the survey estimated at over $700,000, however, a shortfall of over $200,000 had to be overcome before the project could be commenced.

To help reduce overall costs, the BC Ministry of Transportation and Highways (MOTH) agreed to coordinate its annual traffic counting program with a Fall survey, to undertake counts at some additional screenline and cordon points, and to assist in the supervision and set-up of cordon stations on major highways at which travellers leaving or entering the survey region might be given a travel survey form to complete. BC Transit and GVRD's member municipalities also agreed to coordinate their traffic counting programs with a Fall survey and to undertake additional counts at specified points within their jurisdictions. As further testament of their commitment to the survey project, GVRD's member municipalities approved funding of $100,000 for 1986 to allow the project to be funded over two budget periods. Member municipalities also agreed to a priorization and phasing of survey components: more important components would have first call on available funds with projects of lesser importance to proceed if and when sufficient resources could be shown to be available in light of actual expenses. Notably, it was agreed that a survey of truck travel would be delayed until funding sufficiency was confirmed.

Since the federal and provincial contributions were derived from the ALRT Impact Assessment, it was necessary to contract with the GVRD as a subcontractor to the Impact Assessment. Execution of this contract in May 1985 initiated the survey preparation phase of the regional travel survey.

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(1) The Development Services Department provides centralized data base and transportation modelling services to member municipalities. It also provides secretariat and research support to the advisory committees of municipal planners, administrators and politicians that meet to discuss planning issues and matters of intermunicipal policy or strategy. Membership of municipalities is on a voluntary basis, renewable annually. Participating municipalities approve the department's annual program and budget and share the program's cost in proportion to their taxation assessment totals.

3. TELEPHONE INTERVIEW SURVEY

3.1 Preparations for the Survey

3.1.1 Establishing an Implementation Team

In May 1985, in anticipation of the eventual decision to proceed, Development Services hired Mr. David Baxter of Daedalus Investments Incorporated, a Vancouver-based management consulting firm, to oversee the design of the telephone interview survey. The coordinator convened a committee of municipal transportation planning staff as a working group to provide technical input and liaison between the project's managers and its "sponsors." At the outset, it was recognized that the need to ration funds might influence decisions between what would be achievable versus what would be most desirable. Secondly, it was recognized that interviewing had to proceed within a fixed time period starting in September and ending prior to the start of service on SkyTrain in January 1986; nothing before or during the key period could be allowed to prevent interviews being carried out. These constraints had significant implications in terms of decisions that were eventually taken regarding the method and process of the telephone survey.

3.1.2 Technical Issues Requiring Resolution

Several related technical issues had to be resolved. These were: the determination of the survey frame, including the source and coverage of the survey sample and its target size; the method of collecting and recording data; and, the specification of the information to be collected.

3.1.2.1 Survey Area

As to the spatial coverage of the telephone survey, three options were considered. At the largest scale, a survey covering the entire Lower Mainland of British Columbia from Vancouver to Hope would be most comprehensive. On the other hand, with no financial contribution from these other areas, the additional cost of the larger scale survey was felt not to be justified. Similarly, the option of restricting coverage only to the GVRD area was not acceptable since there is significant travel between GVRD and its neighbouring municipalities to the east and insight into this travel would be lost.

A third option was to cover the Vancouver Census Metropolitan Area (CMA). The CMA as shown in Figure 2 includes all GVRD municipalities and, to the east, the City of Langley and the District of Langley on the south side of the Fraser River and the District of Maple Ridge and the District of Pitt Meadows north of the Fraser. (In 1985, the CMA contained approximately 522,000 households with 1.35 million people.) The CMA includes most of metropolitan Vancouver's "travelshed." With relatively few points of (roadway) entry into the CMA's borders, the measurement of externally-originating travel would be simplified. By coincidence, the Greater Vancouver Toll-Free Dialing Zone almost exactly matches the CMA boundaries. Thus, the CMA was chosen as the survey area.

3.1.2.2 Sample Size

The feasibility study had recommended a target of 6% of households completing interviews, compared with the 4% rate that is typically sought for surveys in metropolitan areas with populations over a million. This higher rate was recommended considering the long interval since the last comprehensive survey, and to ensure that a sufficient number of transit trips would be sampled.

In the early discussions, a target of 25,000 completions among GVRD households was set. This is approximately 6% of the 450,000 GVRD households, with lower sampling rates being considered for the non-GVRD municipalities further to the east. When it became known that these other municipalities would not contribute to the survey, the target of 25,000 completions was nevertheless retained for the CMA area. As it happened, 25,180 interviews were eventually completed among the CMA's 522,000 households, for a sampling rate of 4.8%.

3.1.2.3 Sampling Method

Having agreed on the telephone interview method, the advisory committee undertook with B.C. Telephone to specify a sampling procedure. B.C. Telephone had indicated that it could provide a random sample of listed residential telephone numbers from each of its three-digit central bureaus (i.e. 432-xxxx) or from each of its two-digit exchange zones (i.e. 43x-xxxx) that make up the Greater Vancouver Toll Free Zone. For each of the 117 central bureaus, B. C. Tel provided a count of the total number of residential telephone subscribers and the total with listed phone numbers, all drawn from their August 1985 billing records. On the assumption that 60% of households in the eventual master sample would complete interviews, and allowing for multi-listing households and for B. C. Tel's committed numbers which were not yet in service, a crude sampling rate for each of the central bureau files of listed telephone numbers was calculated, generally about 10.5%. Every "nth" record was drawn according to the crude rate and the name and full address of the customer was associated with the drawn telephone number. This file was then "shuffled" into random order by B.C. Tel to develop a master sample file, and sequential survey code numbers were attached to each record in the randomized file.

In Greater Vancouver, telephone subscribers are required to turn in their old numbers if they relocate to outside of the exchange area. Thus, the sampling method ensured that there was no systematic spatial bias.

3.1.2.4 Data Entry Procedures

Extensive investigations had been conducted by Dr. Steuart on the feasibility of using procedures for on-screen data entry, automatic data editing and verification and direct geo-coding. The advisory committee recognized, however, that considerable time and effort would be required to develop and field test the various systems, to acquire and install the necessary equipment, and to train the interviewing team and support staff in the use of the systems. The group also saw some likelihood that the related activities would not be finished in time for a September start. And, without thorough field testing, the possibility loomed large that a system problem might shut down the key process of interviewing. Accordingly, an early decision of the group was to proceed with the development of as many ancillary automated procedures as possible, but that the method of recording and storing data would be via the "tried and true" steps of recording data onto paper survey forms followed by keypunching.

Appendix F describes the automated procedures that were established. Considerations are also outlined which are germane to the choices between "on paper" versus "on screen" data entry and to the choice as to whether or not to set up a direct geo-coding procedure.

The advisory group also concluded that, despite the desirability of increasing the in-house knowledge base, it would be necessary to retain consultants to develop the automated systems and to conduct the telephone interviews. (The consulting firms that were eventually selected were Compuplan Computer Services Corporation to undertake the systems development, and Canadian Facts, a marketing research firm, to undertake the interviewing.) Before doing so, however, it was necessary to anticipate the data that would be collected and the automated procedures that would be invoked. In the case of the interview contractor, it was also necessary to anticipate the interview procedure, having implications for the design of the script and recording forms and the time it would take to complete an interview.

3.1.2.5 Interview Content

In preparing initial drafts of the scripts and interview procedures, the group referred frequently to the Montreal survey experience. An overall philosophy or strategy was adopted to the effect that procedures should be kept as simple as possible for both the interviewee and the interviewer. From the interviewee's perspective, this meant that the interview should proceed in an understandable fashion and should ask for clearly relevant information. For the interviewer, this objective was, in part, fulfilled by the decision to use paper recording forms. Secondly, by keeping their coding task to a minimum, interviewers could better concentrate on recording the data being relayed to them. Appendix C.1 contains the final versions of the interview script, coding conventions and coding forms. As Appendix C.1 shows, all coding conventions required of interviewers could be listed on two pages. Of these, only the table that related bus route names to bus route numbers would have defied memorization after more than a few days.

3.1.4 Establishing Interviewing Teams and Procedures

3.1.4.1 Structure of the Interviewer Team

Using the Montreal surveys as a guide, the advisory group estimated the number of interview completions they could expect per interviewer hour. Then, considering that interviews would occur five hours per day, five days per week over a nine week period, they estimated that it would take 24 interviewers to obtain 25,000 completed interviews.

The interviewing consultant advised that the best structure for the interviewing group would be as four teams of six interviewers, each of the teams to be overseen by a team leader who would report to an overall project supervisor. The role of each team leader would be to supervise and monitor the team members, to ensure that members had the supplies, samples and instructions they needed, to perform a preliminary edit of the completed forms, and to participate, as time allowed, in the actual interviewing. As well as supervising the overall procedure, the project supervisor would provide liaison between the interviewing team and the firm's management for administration purposes and between the team and the client.

3.1.4.2 Pre-Testing and Training

From its roster of experienced interviewers, the consultant selected the four team leaders in mid-August, 1985. Following some initial training sessions to familiarize them with the survey's objectives and anticipated procedures, the team leaders participated in the first survey pre-test. This pre-test, conducted by "cold calling" interviewers' friends and family, was intended to refine the interview script, recording form and interview procedure. Then, working with Baxter and a forms-design consultant, the team leaders participated in the design of the survey coding form.

In late August, a second pretest was carried out as a "dress rehearsal" for the full-scale survey, and to obtain better estimates of such parameters as refusal rates, trips and trip segments per person and per household, and completions per hour. A sample of 200 households, randomly selected from the telephone book, was interviewed, having first been sent an information letter explaining the purpose of an impending interview. Following final refinement to the script and coding form, the forms were printed and the interviewing consultant began engaging and training staff.

(The recording form is shown on page C-10. Of actual size 11 inches by 14-7/8 inches, it was printed on continuous-form, sprocket-holed paper, thereby allowing for the sample code number and the name, full address and telephone number of the household to be printed by computer using the master file. The form was designed to facilitate accurate data recording and subsequent editing, as well as to provide visual cues reinforcing the sequence of questions in the interview script. It can be recommended as a model to others who might conduct a travel survey.)

3.1.4.3 Interviewing Procedures

Final decisions were also taken at this time as to interviewing procedures and as to what would constitute a completed interview. These decisions included the following:

(a) To obtain travel data spanning the Monday through Friday work-week, interviews were scheduled on Tuesday through Friday from 4:45 p.m. to 9:45 p.m., and on Saturdays from 10:30 a.m. to 3:30 p.m. No interviewing would proceed on statutory holidays or the day following.

(b) Three attempts were to be made to reach each household, each subsequent attempt to be on a different evening. After three unsuccessful attempts, the household would be declared "dead." Three calls (not including busy signals) at different times spaced over the same evening would constitute one unsuccessful attempt.

(c) Data was to be obtained on the travel of each and every household member over the preceding calendar day (from 00:00 a.m. to 12:00 p.m.).

(d) Data was to be obtained from one or more non-child members of the household, preferably from members over the age of 18.

(e) Although the person or persons providing data might not know all of the trip making of other, absent household members, the recording of data that could be obtained would nevertheless constitute a completed interview.

(f) Table 1 shows the data that would be obtained in each completed interview, including data on the household, each person in the household and the trips they made.

TABLE 1
Telephone Interview Data Content

Household and Personal Data	Trip Data
Size of household # of vehicles in household # of employed persons in household Age of each household member Sex of each household member Municipality of residence Traffic zone of residence* Postal code zone of residence Telephone exchange of residence Date for which data provided Day of week for which data provided	Person making trip Trip number Purpose of trip Mode of trip segment Time of trip start Driver/passenger Bus routes used Description of origin, destination Traffic zone of origin, destination UTM of origin, destination* Municipality of trip segment end Traffic zone of trip segment end* Type of origin, destination (i.e. landmark, intersection, specific address)

(g) Data was to be obtained on a trip segment basis. (A trip is a journey for a single purpose; segmented trips typically involve mode changes or intra-mode transfers as the person continues to pursue the journey purpose.) A complete trip segment record would include the segment's origin and destination, starting time, trip purpose mode, method (i.e. driver or passenger) and the number of the bus route if one was used.

(h) A complete origin or destination description would include a municipality code, a description in the text field, and a single-digit ID-code distinguishing street addresses from intersections from "monuments" (place names). For each person in the household, the interviewer was to record their first origin and all destinations. Subsequent origin descriptions would be derived from the preceding destination description.

3.1.5 Public Information and Public Relations Activities

3.1.5.1 Media Coverage

The date of the first interviews - Tuesday September 10, 1985 - militated against extensive publicity prior to kick off. Prior to the reopening of schools, people are either not at home - or, if at home, are not "tuned in" enough to their newspapers, TV's and radios - for a summer publicity campaign to be effective. For this reason, and to ensure that the news about the impending survey was sufficiently fresh in the minds of the public, the publicity campaign was timed to start the week prior to the start of the survey.

Rather than using paid announcements - which are expensive and are typically ignored - the advisory group sought to have information about the survey treated as news, in particular, news of interest and relevance to each of the local communities. One-page and five-page press releases were distributed to community newspapers and to radio and TV stations. Using a word processor, these releases were tailored in minor ways for each target area. Community newspapers are typically distributed at no charge to all households in their respective areas and are generally well read by people seeking the area-specific information and ads that are often not provided in sufficient depth by the metropolitan dailies. And, community newspapers are often hungry for "copy", as proven by the number of papers that ran the press release, including its longer version. Figure 4 shows a typical article that appeared in a community paper. The press releases also stimulated modest coverage in the electronic media and metro dailies.

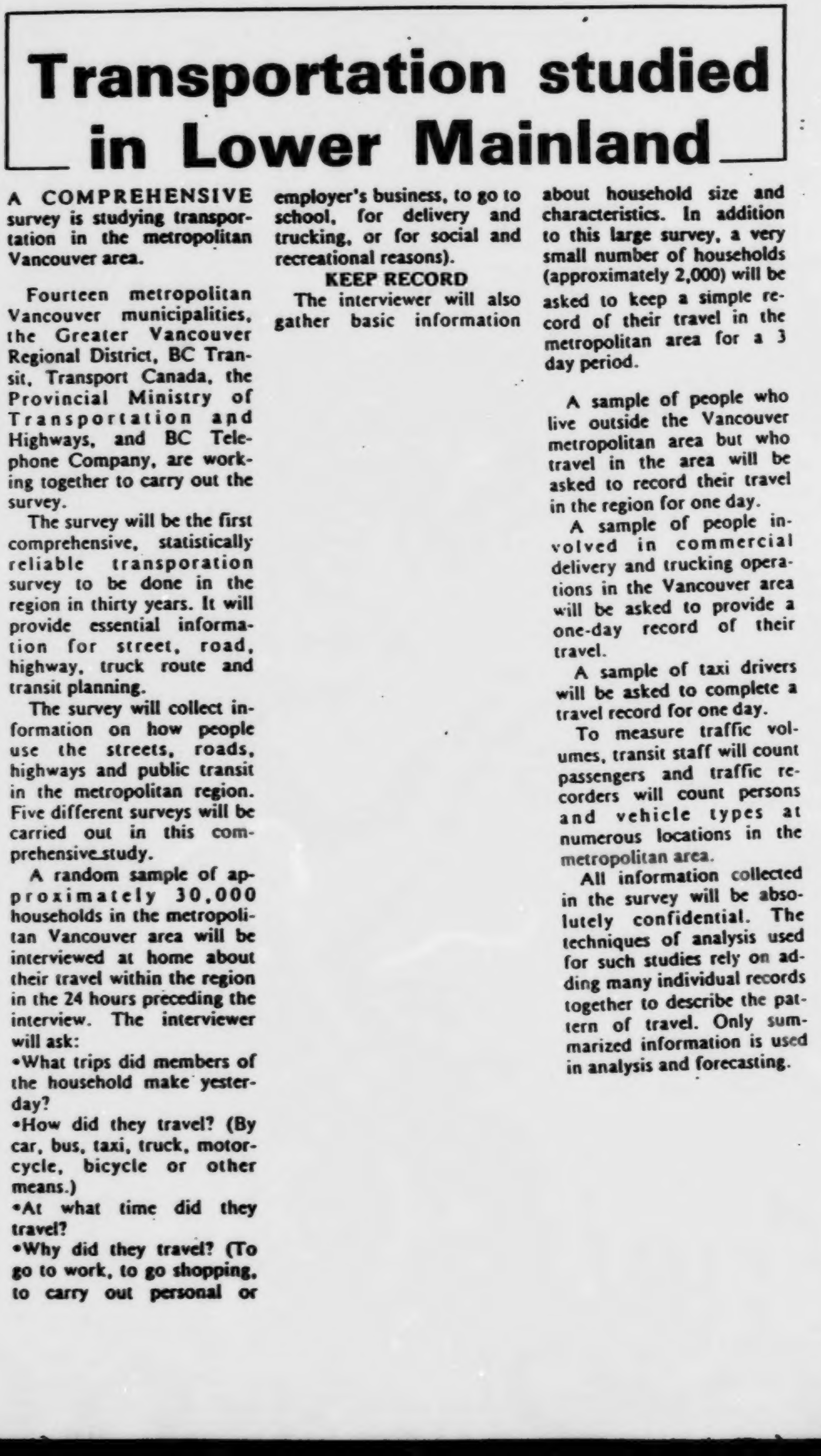
3.1.5.2 Inquiries and Contact Letter

In the wrong hands, knowledge that someone lives alone or might typically be away from home at certain hours could be very valuable. Consider the vulnerability that senior citizens might feel. Accordingly, a key element of any travel survey is the program by which the existence of the survey and its community benefits are made known, and the mechanism by which fears and suspicions can be allayed.

City Hall or the Police Department are often the first places people call to complain about or to check the legitimacy of persons asking sensitive questions over the telephone. The press releases and other information items were distributed to the mayors, police chiefs and senior administrators in each of the CMA municipalities. These contacts were followed up by telephone calls on the day prior to the start of the survey.

Probably the most important communications device, however, was the contact letter, shown in Figure 5. Considerable care, involving numerous redrafts, edits and critiques, went into its preparation. While maintaining conciseness and readability, several key points had to be communicated including the sponsors and their legitimacy, the objectives of and need for the survey, the importance and utility of each person's participation, an assurance of confidentiality, and a preview of the survey format including the time of day when interviewing would take place and the nature of the information that would be solicited. In addition, the contact letter provided the name of a person - Barbara Kelly - that someone with misgivings might contact for assurance or further details. In fact, there was no person named Barbara Kelly, but it was a useful way to quickly route incoming calls to an appropriate person.

Figure 4
Typical Community Newspaper Article



Transportation studied in Lower Mainland

A COMPREHENSIVE survey is studying transportation in the metropolitan Vancouver area.

Fourteen metropolitan Vancouver municipalities, the Greater Vancouver Regional District, BC Transit, Transport Canada, the Provincial Ministry of Transportation and Highways, and BC Telephone Company, are working together to carry out the survey.

The survey will be the first comprehensive, statistically reliable transporation survey to be done in the region in thirty years. It will provide essential information for street, road, highway, truck route and transit planning.

The survey will collect information on how people use the streets, roads, highways and public transit in the metropolitan region. Five different surveys will be carried out in this comprehensive study.

A random sample of approximately 30,000 households in the metropolitan Vancouver area will be interviewed at home about their travel within the region in the 24 hours preceding the interview. The interviewer will ask:

•What trips did members of the household make yesterday?

•How did they travel? (By car, bus, taxi, truck, motorcycle, bicycle or other means.)

•At what time did they travel?

•Why did they travel? (To go to work, to go shopping, to carry out personal or employer's business, to go to school, for delivery and trucking, or for social and recreational reasons).

KEEP RECORD

The interviewer will also gather basic information about household size and characteristics. In addition to this large survey, a very small number of households (approximately 2,000) will be asked to keep a simple record of their travel in the metropolitan area for a 3 day period.

A sample of people who live outside the Vancouver metropolitan area but who travel in the area will be asked to record their travel in the region for one day.

A sample of people involved in commercial delivery and trucking operations in the Vancouver area will be asked to provide a one-day record of their travel.

A sample of taxi drivers will be asked to complete a travel record for one day.

To measure traffic volumes, transit staff will count passengers and traffic recorders will count persons and vehicle types at numerous locations in the metropolitan area.

All information collected in the survey will be absolutely confidential. The techniques of analysis used for such studies rely on adding many individual records together to describe the pattern of travel. Only summarized information is used in analysis and forecasting.

THE METROPOLITAN VANCOUVER
ORIGIN-DESTINATION SURVEY

600 - 4330 KINGSWAY, BURNABY V5H 4G8

Figure 5
Contact Letter

John Smith
1234 Ampstreet Drive
Vancouver, B.C.
A1A 1B1

Your household is one of a selected sample of households we are asking to participate in a special survey of travel patterns in Metropolitan Vancouver. The purpose of the survey is to obtain information needed for street, road, highway and transit planning.

Within the next few days, a telephone interviewer will call and ask to speak to yourself or another adult member of your household. They will identify themselves as calling from the Metropolitan Vancouver Origin-Destination Survey. The interviewer will ask questions about the travel of all the members of your household for the day before the telephone call. The questions will be about when they travelled, where they went, how they travelled, and the reasons for travelling. The interview will take only a few minutes.

The interviews are being conducted by Canadian Facts, an independent survey research company. Information gathered will be kept absolutely confidential. Individual results will not be used directly. Rather, they will be added together for each geographical area to obtain an overall travel pattern.

The interviews will be carried out Tuesdays to Fridays between 4:45 in the afternoon and 9:45 in the evening, and on Saturdays between 10 o'clock in the morning and 3 o'clock in the afternoon. Please let the other members of your household know that the interviewer will be calling during the next few days. Perhaps you could put this letter in a convenient place as a reminder.

If you have any questions or concerns about this survey, please call Barbara Kelly at Canadian Facts, 669-3344.

We thank you in advance for your cooperation. We appreciate your contribution to this vital community-wide project which will help to improve the transportation system in Metropolitan Vancouver.

Yours truly

David Baxter

David Baxter, Project Coordinator

THE MUNICIPALITIES OF BELCARRA, BURNABY, COQUITLAM, DELTA, NEW WESTMINSTER, NORTH VANCOUVER CITY,
NORTH VANCOUVER DISTRICT, PORT COQUITLAM, PORT MOODY, RICHMOND, SURREY, VANCOUVER, WEST VANCOUVER, AND WHITE ROCK,
B.C. MINISTRY OF TRANSPORTATION AND HIGHWAYS, B.C. TRANSIT, AND TRANSPORT CANADA,
WITH THE COOPERATION AND ASSISTANCE OF GREATER VANCOUVER REGIONAL DISTRICT AND THE B.C. TELEPHONE COMPANY.

The contact letters were printed at GVRD on high-quality, continuous-form bond paper. A word processor linked to the master file was used to type the name and address and current date to create the impression that each letter had been personalized. Throughout the survey period, GVRD staff were in contact with the interviewing team supervisor to time the mail out of contact letters so that they would arrive on the Tuesday of the week in which the household would likely be called.

For understandable reasons, survey organizers and sponsors were in a state of some apprehension throughout the survey period lest various miscreants use the opportunity of the survey for their own ends. Any such events would have been extremely newsworthy and might have led to high refusal rates if not an outright shut down of the survey. Fortunately, no such instances occurred. Nevertheless, it was money well spent, at the completion of the survey, to take out ads in the community newspapers and dailies announcing the end of the survey and thanking the population for its participation. By implication, however, it was inferred that any subsequent telephone contacts seeking information did not originate from the survey.

3.2 Daily Activities During The Survey And Post-Survey Periods

3.2.1 Daily Routine at the Interviewing Firm

3.2.1.1 Quality Control

At the start of each evening, short meetings of the entire group or of the individual interviewer teams were held for supervisors to convey instructions. These meetings also provided the opportunity for pep talks and for the interviewers to ask questions or make suggestions. Much like Japanese quality control circles, these meetings produced useful suggestions and helped to foster team spirit and positive norms of behavior.

After the meeting, each interviewer was issued a file of "new" sample and a file of call-backs. After each call, the interviewers passed the recording form to their team leader. The team leaders put incomplete forms into their appropriate stack (i.e. not in service, try a second time, etc.) and conducted a preliminary edit of the completed forms. In this way, forms with incomplete or missing data could be returned for an immediate call back.

A second means of quality control was call monitoring. Team leaders were equipped with headsets that enabled them to cut in and out of on-going interviews without either party being aware. The team leader could thereby ensure that the interview script was being followed, that sufficient effort was being made to obtain data from reluctant interviewees, that the interviewers were being thorough, efficient, etc.

Possible Biases in the Methods used in the Telephone Interview Survey
As a means of collecting representative travel data, the particular methods used in the Metropolitan Vancouver telephone interview survey might be challenged on several grounds as having introduced bias into the results that were obtained.

CHALLENGE 1: HOUSEHOLDS WITH LISTED TELEPHONES ARE NOT REPRESENTATIVE OF ALL HOUSEHOLDS.

CHALLENGE 2: THERE COULD BE SPATIAL BIAS IN THE SAMPLING METHOD.
The telephone company, B.C. Telephone, estimates that over 98% of Greater Vancouver households have telephones. It can also be suggested that the overall socio-demographic characteristics of "phoneless households" and "unlisted households" from any given area are similar to those of their immediate neighbours with listed numbers. The sampling method minimized spatial bias by drawing listed telephone numbers by exchange zone in proportion to the zone's known population. Indeed, the results presented in Chapter 4 show the close correspondence (on a municipality-by- municipality basis) between the surveyed sample and the CMA's population. Accordingly, the above two challenges can be rebuffed.

CHALLENGE 3: TELEPHONE SURVEYS UNDER-REPRESENT ONE-PERSON HOUSEHOLDS.
Results presented in Table 13 suggest that, in both the telephone survey and the trip diary, the proportions of one-person households in the realized sample are lower than that expected in the population. Thus, the challenge is valid. In view of the sample-to-population expansion procedure that was used, a bias could be introduced to the extent that trip making by persons in one-person households differs from persons in larger households.

CHALLENGE 4: BECAUSE ONE HOUSEHOLD MEMBER WAS ALLOWED TO REPORT ON THE TRIP MAKING OF ALL MEMBERS, THE REPORTER MIGHT NOT KNOW OF OR REMEMBER THE TRIPS OF OTHER MEMBERS, LEADING TO UNDER-REPORTING.
Results presented elsewhere in the report show that this challenge is valid when considering overall trips rates. In expectation of this, the trip diary survey was conducted to give a better basis for trip generation analysis, with the telephone survey results mainly intended for trip distribution analysis. Results also show, however, that there does not seem to be significant under-reporting in the telephone survey results for peak periods, these periods being characterized by "important", habitual and easily-remembered trips.

CHALLENGE 5: THE TELEPHONE SURVEY WILL HAVE MISSED HEAVY TRAVELLERS.
Especially since we "gave up" after three unsuccessful contact calls, it might be argued that heavy travellers who would not be home to answer

their telephones would have been under-represented in the telephone survey. If this were the case, it must also be true that households reached on the first attempt must, overall, be "lighter" travellers thanthose reached on the second call, etc. The results below, from a sample sub-set of about 1000 completed interviews, show that such a direct relationship between trip rates and successful contact call number is not consistently observed. The indication is, therefore, that any extraeffort and expense to call back "absent" households would not have been warranted.

NUMBER IN HOUSEHOLD	CALL NUMBER WHEN CONTACT MADE								
	1			2			3		
	AVG	SD	N	AVG	SD	N	AVG	SD	N
1	2.5	2.2	127	2.5	1.3	50	2.7	1.5	30
2	5.1	3.5	215	5.7	3.9	96	4.4	3.0	36
3	8.1	4.7	105	7.5	5.2	40	7.4	5.1	15
4	10.8	6.5	112	10.5	7.1	39	9.8	5.8	17
5	14.4	7.8	40	15.2	8.7	17	12.4	9.0	5

AVG = Average trips per household per day
SD = Standard deviation
N = Number of observations

CHALLENGE 6: THE TELEPHONE INTERVIEWS MISSED "NIGHT PEOPLE".

Apart from interviews (for Friday's travel) conducted on Saturday afternoons, interviews were mainly conducted in the evenings, thus potentially missing people whose work or play at night keeps them away from home. A mini-survey was conducted to test this premise, whereby 400 households were called during the period from 10:00 to 15:00 on weekdays.

A total of 110 households were reached in the 400 calls, leading to 60 completed interviews. The profiles of household size and trip making for these 60 households were not significantly different from those of the rest of the surveyed sample. The respondents were also asked whether someone in the household worked an evening shift. This was the case in 8 of the 60 households, but only 2 of these households were one-person households where no one could have been home to respond to an evening interview. It was concluded that the challenge is valid but that the biasing effect is small. The greater costs and inefficiencies of surveying in the afternoon would not be justified.

CHALLENGE 7: THE TELEPHONE SURVEY METHOD IS NOT CONDUCIVE TO OBTAINING DATA ON COMMERCIAL AND BUSINESS-RELATED TRAVEL.

This challenge is valid: people who travel extensively for work or business purposes might not be willing or able to report all their trips, and most of these trips would not be known at all to/by other household members. Chapter 7 describes the special "Survey of Travel for Work and Business Purposes" that attempted - unsuccessfully - to deal with this problem.

Monitoring by staff from GVRD and the municipalities was also possible, using headsets set up outside of the main interviewing area. The option of hiring a full-time monitor independent of the interviewing firm had been rejected because of its expense and limited effectiveness. Instead, a schedule was set up, assigning monitoring duty to each member of the client group. For municipal staff, the monitoring sessions had the additional benefit of demonstrating both the quality and the limitations of the data being collected.

3.2.1.2 Data Editing

The following morning, all completed interview forms from the previous evening were subjected to a further examination and editing by a team of three editors. Forms requiring call back or clarification were returned to the interviewers for that evening's session; completed forms were sent by courier to the data entry/keypunching contractor.(1)

The editors also assembled statistics on the productivity of each interviewer and on the quality of each one's work (e.g. completeness, adherence to conventions, etc.) as the basis for possible corrective actions. These corrective actions included further individual or group training, and in extreme cases, the interviewer was let go. Considering also the voluntary departures, training and retraining was an on-going activity, with 45 people being trained over the survey period to staff the 24 interview stations.

(iii) The Progress of the Telephone Interview

Table 2 shows the progress of the telephone interview survey over its twelve week period.(2) Based on these statistics, the following comments can be made:

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(1)The interviewing consultant estimates that from 10% to 15% of forms were returned to interviewers for clarification after the initial edit by team leaders. In many of these cases, a call back was not necessary if the interviewer could supply the specification based on his or her recall of the interview. About 1% to 2% of forms were returned to the interviewers after either the second edit or following examination at GVRD. To limit unproductive recalls, interviewers were instructed to note, in the Comments section of the form, when the respondent was either unwilling or unable to provide the information that would otherwise be required.

(2)Based on the Montreal experience and the results of the pre-tests, it was originally estimated that the telephone survey would take nine weeks and end in mid-November. At a mid-point review, it was apparent that the interviewing period would have to be extended by three weeks to reach the target of 25,000 completed interviews.

TABLE 2
PROGRESS OF THE TELEPHONE INTERVIEW SURVEY

PROGRESS OF TELEPHONE SURVEY								
WEEK	COMPLETIONS	HRS	COMPS PER HR	% COMP	% PHONE NUMBER CHANGED	% REFUSE	% NO CONTACT	% FOREIGN LANG.
1 & 2	3020	945	3.2	59	4.6	21	12	3.4
3	1652	459	3.8	61	4.9	19	13	2.4
4	2108	484	4.4	59	5.5	17	15	2.8
5	2377	572	4.1	62	4.1	21	12	2.0
6	2212	508	4.4	59	5.8	19	14	2.3
7	2723	578	4.7	61	6.3	18	13	2.6
8	2483	482	5.1	58	6.7	17	16	2.0
9	2403	480	5.0	60	6.7	18	14	2.1
10	1793	339	5.3	57	7.1	18	16	1.8
11	2280	411	5.5	60	8.7	18	11	1.9
12	2143	408	5.3	51	6.8	21	13	2.9

(a) As shown by the trend in completions per hour, steady improvement in interviewer productivity was made over the survey period indicating learning curve effect. Behind the scenes, the combined effects of the continuous training and the team approach were important. Namely, through the team leaders, interviewers received instant feedback on their errors and on ways they could improve their methods. Interviewers were also free to bring forward their own suggestions for improving methods. This opportunity for involvement, the cohesiveness of the team unit (with friendly rivalry between teams), and the reinforcement methods of the team leaders and supervisors (feedback, stroking and monthly parties after Saturday interview sessions) all combined to build high morale and loyalty among interviewing staff. Slacking off and turnover was almost certainly lower than it otherwise might have been, and the contractor was better able to retain good interviewers and benefit from the investment in training.

(b) As a caveat on the trend of steadily increasing productivity, the highest completion rates per hour are associated, in the final two weeks, with the lowest averages of trips per household. It may well be that the variations in trip averages correspond to some "real" seasonal or weather or random effects. On the other hand, it may have been that interviewers were mindful of the impending end of the project and of the objective of 25,000 completions and were somehow influenced. Nevertheless, the statistics from preceding weeks - showing high completion rates and high trip averages - are evidence of true productivity improvements.

(c) At about 18%, refusals to participate did not vary greatly over the survey period. Similarly, the percent of households that could not be reached (after three attempts on different evenings at different times) was relatively constant at about 14% over the survey period.

(d) Sample aging was anticipated to be a problem: recall that the sample was drawn from B. C. Telephone's August billing records, such that the number of out-of-service or changed numbers was expected to increase over the survey period (1). This upward trend was observed in terms of the percent of respondents with % phone number changed but this did not prove to be a significant problem.

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(1)The telephone company's automated systems would announce that a number had been changed. These interviews were not pursued because the relocations might have been to a different exchange area, thus affecting the basis of stratification. Interviews were pursued if a different household than the one named was reached at the named telephone number; these households would still be within the same exchange area. In these situations, the new household address was noted.

(e) Language problems, including deafness and situations where no household member of sufficient age could speak English, fluctuated around 2% through the survey.

(f) Finally, the rate of successful completions stood at about 60% throughout the survey period, or about 75% of households where contact was made.

3.2.2 Daily Routine at GVRD

3.2.2.1 Data Entry

The interviewing consultant sent each evening's completed survey forms by courier to the data entry/keypunching contractor by noon of the following day. After entry and verification, the forms and the resulting computer tape were sent by courier to the GVRD offices, arriving in the early evening. That evening, separate files would be created and printed out of the demographic and trip segment data. In addition, new files would be merged with the accumulating files from previous interviewing.

The GVRD's editing and coding team included one research assistant and two clerks. Each morning, the research assistant would invoke several verification and diagnostic routines. (Appendix F outlines the duplicate key checks(1) and other "range and completeness" checks.)

The diagnostic and verification routines caused various reports to be printed, typically identifying the key number and an appropriate error code number. A task of one of the clerks was to inspect the print-off of the files or the actual coding forms to attempt to rectify the particular problem. The correction was then entered into the electronic record.

The task of the second clerk was to sort and file the incoming survey forms so that any one could be quickly found in subsequent editing or geo-coding tasks. As this was being done the Comments section was checked for "flags" indicating that the household contained a person(s) travelling extensively for work and business purposes. (See Section 7). These flagged records were then segregated into a separate file.

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(1) The data base employs a keyed file, the key being "built" in the order: sample number; person number; trip number; trip segment number. Each household, person, trip and segment is uniquely identified and can be directly summoned.

3.2.2.2 Verification of Trip Ends

A further task was required each day to keep pace with the incoming data. Namely, the research assistant would scan the print-offs of the trip records to determine if the trip ends appeared to be geo-codable. After noting trip ends with potential problems, he would check the corresponding coding forms for further information. This could include entries in the Comments section (which might also show that the interviewer was unable to obtain a more precise specification). Sometimes, insight into one person's travel could be derived from the trips of other household members. In other cases, the locus of travel could be estimated such that otherwise imprecise specifications (e.g. "McDonald's" or "the Library") could be fixed with reasonable confidence. The appropriate specifications were then entered into the electronic record.

Forms containing imprecise trip ends which could not be located were segregated, to be returned to the interviewers for call back. As the survey progressed, proportionately fewer records were returned for call back. There were several reasons for this. First, in the early stages, relatively more forms had problems while the editors and the interviewers were "getting up to speed." Secondly, it was often hard to justify the effort and cost involved to return forms. At about $20, the cost of a courier to take forms from GVRD offices to the interviewing site could not be justified each evening if there were only a few trips to be subject to call back. As well, there was the cost of the interviewers' efforts in trying to reach the particular household. Thirdly, once made, the effort and expense typically had little pay off: the trip often could not be remembered and hostility was frequently encountered from people who felt bothered for "trivial details." Thus, the process of verifying codability was ultimately directed more to assisting the geo-coding than to identifying candidates for call backs. The records that were returned however, served to keep the interviewing/editing team on their toes.

The feasibility study had proposed that geo-coding could be, for the most part, done automatically as data was being entered, such that there would only be a small sub-set of un-geo-coded trip ends. This subset could be quickly examined such that call backs could be initiated within 24 hours. In the actual survey, geo-coding was not immediate and automatic. All trip ends had to be inspected manually and it was at least 48 hours - and frequently longer - before a call back could be initiated. This speaks to the importance of an immediate edit of the coding forms at the interviewing station. As it happened, the first edit by team leaders could lead to call backs within 15 minutes, increasing the likelihood that someone would be home, would recall the trip and would be understanding about the second "intrusion." The next edit undertaken the following morning by the editing staff could see forms returned for call backs that evening.

3.2.2.3 Geocoding

Having completed their tasks required to keep pace with incoming survey forms, the clerks could then turn their attention to geo-coding trip ends. The purpose of geo-coding was to identify the precise locations of trip ends and household locations using Universal Transverse Mercator (UTM) coordinates. These UTM coordinates could then be located within the proper traffic zone. (Appendix F describes the automated procedures to assist in geo-coding.)

In total, approximately 30% of the 354,000 trip segment ends reported in the survey (approximately 170,000 trips) were monuments, with about 16,500 different monuments being named. Monuments were places that were identified by name, such as "The Bay", "Freda's Hair Salon" or "Vancouver General Hospital". (This includes the same places specified under various spellings.)

About 40% of trip segment ends were specified as the home location, with a further 5% being specific (non-home) addresses. Thus, it was necessary, in total, to geo-code approximately 30,000 separate addresses.

About 20% of trip segment ends were specified as intersections, with about 11,500 different intersections being named. During the process of assigning trip ends to traffic zones, a routine was invoked to randomly off-set the UTM coordinates of trip ends specified as intersections from the UTM coordinates of the intersection. Otherwise, in situations where two or more traffic zones meet at an intersection, all trip ends might have been located in one traffic zone with none in the other(s), depending on where the records' UTM coordinate fell in relation to the borders of the traffic zones.(1)

A fourth category of trip segment specification recognized that respondents would sometimes be unwilling or unable to provide precise specifications. About 5% of specifications fell into this category. About 60% of these specifications were "refused" or "unknown", although in many of these cases the municipality of the trip segment end was specified. A one-by-one examination of the file was made, with corrections being added directly into the data base. In some cases (e.g. for specifications such as "Downtown") the trip ends were randomly assigned to traffic zones within the broadly specified area.

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(1) Other more elaborate offsetting proposals were considered but rejected. One proposal, for example, was to weight intersection quadrants according to their land uses. Extra effort aside, it was noted that this process might not produce more valid results. Consider an intersection with a shopping centre in one quadrant and residential developments in the other three quadrants. Depending on trip purpose, weighting by land use might see more trip ends being assigned to the shopping centre. Yet, it is entirely possible that most people travelling to the shopping centre might have specified its name (i.e. as a monument) rather than give the name of the intersection.

About 4% of trip segment ends (14,000 out of 354,000) could not be located within traffic zones. Although there were imprecise specifications that could be located, there were also monument, intersection and address specifications that could never be found. These included unrecognizable or badly misspelled place names, street names specified as intersecting which are actually parallel, and street numbers/addresses outside of the existing range. For most of these trip segment ends, however, a municipality code specification is available. This municipal code can be used to distribute unidentified trip ends within the proper municipality.

Including the daily activities during the September to November survey period, the task of editing and geo-coding survey data took approximately 30 person-months. The three-person crew worked full-time over the eight month period from September 1985 to April 1986, inclusive. Since then, a further six person-months of effort were expended in various "touch-up" activities.

3.3 Results of the Telephone Interview Survey

3.3.1 Structure of the Data Bases

Appendix D outlines the data bases and data base structures in which results of the telephone survey are stored. Points to be noted are the following:

(a) Master data bases are in secure storage at the GVRD.

(b) Two working data bases have been created by purging the master data bases of "overhead" data and by inserting additional useful data. The two working data bases are OD-DEMO1 containing the household-related and person-related data (i.e. DEMOgraphic data) and ODSRVY: TRPSEG which contains the trip-related data. A key system can be used to link selected household records with the corresponding trip records, or vice versa.

(c) Suppressed "overhead" information includes such confidential information as the name, address the telephone number of the responding household. Also suppressed are the various text and numeric fields containing data required to geo-code the trip segment ends and household locations.

(d) Trip segment ends and household locations have been situated within the appropriate traffic zones, municipalities and "superzones", and these specifications have been carried forward into the working data bases.

(e) Travel data was obtained on a trip segment basis. However, travel analysis will more commonly be on the basis of trips rather than trip segments. Data describing the destination of each trip has therefore been over-written into destination fields for Segment 1 of each trip: this destination-related data includes the mode at the trip end as well as the location codes for the destination. Note that about 96% of reported trips are one-segment trips for which the above process had no effect. For the remaining 4% of multi-segment trips, it is not necessary now to trace the trip chain to complete the description of the trip.

(f) Segment 1 records contain a complete description of both trip ends. Analysis of the individual "links" in a multi-segment trip chain is still possible, however. Although fields that formerly contained the description of Segment 1's destination have been over-written, the description can be "retrieved" from that of Segment 2's origin.

(g) Expansion factors for the sample data have been calculated and inserted into the individual records of the two data bases. Data from the 1981 Census and provisional data from the 1986 Census were used to interpolate 1985 population totals for each traffic zone; these 1985 totals became the numerator of the expansion factor for that zone. The denominator was the total number of persons in the sampled households from each zone.

(h) As shown on the coding form depicted in Appendix C1. the O-D Survey allowed for 12 travel mode specifications (the 11 indicated categories plus transit) and 3 method specifications (driver, passenger, unknown), for a total of 36 possible categores.

Travel mode specifications have been simplified from the 36 possible categories of the survey down to 9 categories. For each trip, the mode at the origin and mode at the destination has been determined, providing a basis for identifying bi-modal trips such as park-and-ride or kiss-and-ride.

(i) The survey's nine categories of trip purpose - essentially "to" purposes such as "To School" describing the destination - have been expanded to 81 categories (9 x 9), now encompassing "from-to" purposes such as "From Home to School" describing the origin and destination.

(j) The GVRD's current model calibration provides estimates of 1985 zone-to-zone travel times for the AM peak hour. These travel times were inserted into Segment 1 records (where the traffic zone of both the origin and destination were known). The data base can thus be used to derive time-start profiles, and with the new field, to determine approximate time-end profiles and trip duration distributions.

(k) Problems have arisen in dealing with "Serve Passenger" trips. (For example, the driver's purpose may be "Serve Passenger" while the passenger's purpose is "To School" giving rise to problems in determining trip generation and auto occupancy factors.) Accordingly, a computer program was written to attempt to identify the "true" purpose (From-To) of the driver, this result being stored as a separate field.

(l) The data bases are considered in the public domain and can be made available at a price reflecting the GVRD's cost of responding to the specific request. GVRD staff have established several procedures on the host system to facilitate the selection of specific data and the packaging of data into useful formats. These procedures include "select and sort" routines to choose and arrange sub-sets of the data. Matrix-building routines have been developed to build trip tables from the selected data if so desired. Data can be output as hard copy or as tape or floppy files which can be formatted to specification and/or for input to programs such as SPSS, d-Base or Lotus 1-2-3/Symphony.

3.3.2 Validation of the Sample

An initial step in the analysis of survey results was to examine whether the various profiles of the sampled persons and households reflect the corresponding known profiles of the CMA population. Such inspections have been made for the age by sex distributions, household size profiles and the distributions by municipality of household locations. Table 3 compares the age by sex profiles of the telephone survey to that of the CMA's population. The presentation of other comparisons between sample and population profiles has been deferred to Section 4 where the corresponding profiles from the diary survey are also presented. The major conclusion from the comparisons that can be noted here, however, is that there is close correspondence between the sample and population on all dimensions.

3.3.3 Inspection of Per Person Trip Making Rates

Table 4 depicts the frequency of reported trip making from the telephone survey. Overall, the average reported trips per person per day, excluding "out of towners," was 2.59. Among those in town and making trips, the average was 3.29 trips per person per day. The highest reported number of trips per day was 30, by one person; the next highest rate was 21 trips, reported by two persons.

TABLE 3
AGE BY SEX PROFILE OF TELEPHONE SURVEY SAMPLE

AGE GROUP	MALES			FEMALES		
	% SAMPLE		% POPULATION[1]	% SAMPLE		% POPULATION[1]
	#	%		#	%	
1 - 9[2]	4061	6.4	6.4	3730	5.9	6.1
10 - 19	4478	7.1	6.5	4179	6.6	6.2
20 - 29	5787	9.1	9.0	5976	9.4	9.2
30 - 39	5718	9.0	8.8	5770	9.1	8.9
40 - 49	3272	6.3	6.2	4003	6.3	6.1
50 - 59	3200	5.0	5.0	3100	4.9	4.9
60 - 69	2701	4.3	3.9	3099	4.9	4.7
70 - 74	814	1.3	1.4	981	1.5	1.9
75+	785	1.2	1.8	1129	1.8	3.0
TOTAL		49.6	49.1		50.4	50.9
NUMBER[3]	31,516		677,545	31,967		703,190

[1] From 1986 Census for Vancouver CMA.

[2] Age specifications in the survey of 0, 98 or 99 have been treated as "Unknown".

[3] In the survey, 1186 male respondents and 1384 females refused to provide their age; 271 respondents provided their age but not their gender; 453 respondents refused on both counts.

TABLE 4
REPORTED TRIPS PER PERSON PER DAY
ALL MODES, ALL PURPOSES

NUMBER OF TRIPS	% OF SAMPLE
0	21.0
1	1.0
2	40.4
3	6.9
4	15.6
5	4.6
6	4.0
7	1.9
8	1.3
9	0.7
10 or more	1.2
Out of Town	1.5

The high proportion of persons reporting that they made zero trips was surprising and somewhat disturbing. The "gut feel" expectation had been that this proportion would be much lower. Figure 6 presents the overall age by sex profile of the "stay at homes".

In a relative sense, the profile appears to be reasonable; proportionately more children, older people and women of all ages are "stay at homes" as would be expected. The high overall number of "stay at homes" might suggest that the response, "No Trips," was a way of avoiding or cutting short an annoying telephone interview. On the other hand, perhaps these people truly did not make any "important" trips over the previous day (including trips to work, to school) even though they may have made short jaunts to the corner store or the community centre. If this were the case, the phenomenon of under-reporting would be of different magnitude depending on the time, purpose or mode of the trip. (Other results are presented later in this chapter on this subject.)

Figure 7 displays the profile of persons reported as being out of town on the survey day. Here too the proportions appear reasonable, being dominated by men of working age. Clearly, however, this must understate the "true" profile of the absent population: where the entire household was away, no one could have answered the telephone.

Figure 6

Stay at Homes

Proportion of Respondents of Known Age

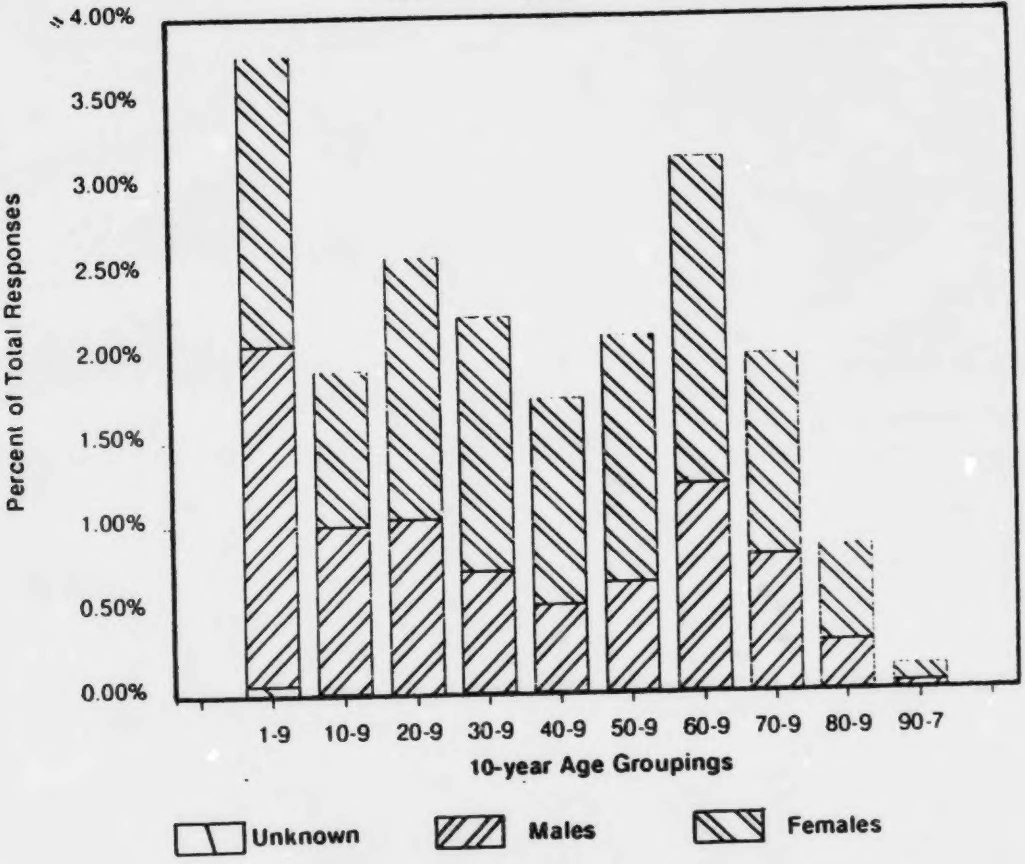

Figure 7

Out of Town

Proportion of Respondents of Known Age

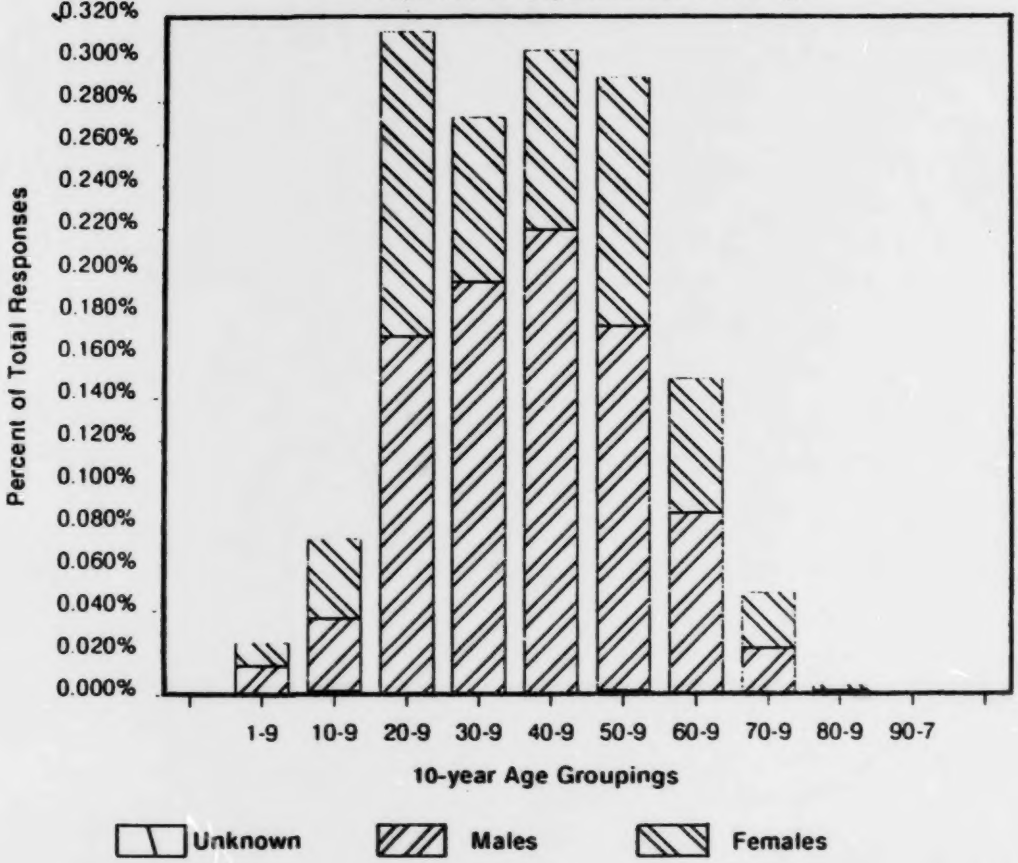

Table 5 presents reported trip making per person per day, stratified by the age of the respondent and by journey mode and purpose. These results were derived from unfactored data by dividing the number of reported trips in each category by the number of persons in the age group. Data on "out of town" persons and persons of unknown age were excluded from the table. The results quantify and confirm some basic expectations about the changing nature and amount of our transportation consumption as we age. Given the overall net aging that Greater Vancouver' population is experiencing, these results point to growth in 24-hour travel demand at a somewhat slower pace than that of the overall population growth.

TABLE 5
24-HOUR TRIP RATES
(Per Person)

	AGE CATEGORY							
	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65+
NUMBER IN SURVEY	4,029	7,853	10,279	12,178	10,091	6,879	5,612	6,833
NUMBER OF TRIP-MAKERS	2,271	6,527	8,788	10,356	8,686	5,483	4,009	3,627
HOME-BASED[1] BY VEHICLE[2]								
HB Work	0.003	0.004	0.729	0.924	0.995	0.945	0.609	0.061
HB School	0.142	0.550	0.713	0.088	0.040	0.018	0.016	0.006
HB Leisure, Shop, Personal Business	1.257	0.534	0.957	0.887	0.910	0.819	0.978	1.024
HB Serve Pass	0.005	0.003	0.118	0.292	0.432	0.223	0.132	0.060
HB Total [3]	1.409	1.092	2.547	2.242	2.448	2.066	1.779	1.158
NON-HOME-BASED BY VEHICLE	0.326	0.164	0.305	0.602	0.671	0.508	0.379	0.206
ALL TRIPS BY OTHER MODES	0.140	1.048	0.404	0.186	0.135	0.109	0.118	0.167
TOTAL:ALL MODES ALL PURPOSES	1.875	2.304	3.256	3.029	3.254	2.683	2.275	1.531

[1] HB Work, for example, includes Home-Work and Work-Home.

[2] Includes Auto Driver, Auto Passenger and Transit Passenger.

[3] Includes other Home-Based trips not reported here.

3.3.4 Travel Profile: Mode by Purpose by Time

Tables 6, 7, and 8 provide complementary descriptions of travel behaviour in Greater Vancouver.

Table 6 presents the profile of mode use by purpose for travel by CMA residents. (It was derived from unfactored survey data records with known time, purpose and mode specificaitons.) It should be noted that the proportions of walk and bicycle trips may not be reliable estimates. Walking trips are the most easily forgotten, and there is the overriding problem of determining when walking is a trip and when it is not. Bicycle trips are most commonly made by children who generally did not provide data in the telephone survey; many of their trips would also have been made away from home, "out of sight" of the person providing travel data.

Table 7 provides a further breakdown by time period. As noted on the table, "Automobile" combines the mode categories of automobile, truck, motorcycle and taxi, and includes both drivers and passengers. An example helps to explain the notation in the bottom part of the table: in the morning peak period (6:46-9:15), 30% of travel is to school, of which 41% is by automobile, 18% is by transit or school bus, and 41% is by walking or bicycle.

Table 8 over two pages shows the pattern of trip making in Greater Vancouver over the course of the day. This tabulation was prepared as part of an exercise to examine the components of travel demand peaking. The reported travel is so-called "vehicle based," including auto drivers, auto passengers and transit passengers. The indicated trip purposes are combinations of the 81 "from-to" purposes described elsewhere. Note too that factored data is presented, and that arrival times rather than departure times are presented, the step of adding trip journey times to reported departure times having been invoked.

TABLE 6

MODE USE BY TRIP PURPOSE
VANCOUVER CMA RESIDENTS

TRAVEL MODE	TRIP PURPOSE								
	TO WORK	AT WORK	TO SCHOOL	TO LEISURE	TO SHOPPING	TO PERSONAL BUSINESS	TO HOME	TO SERVE PASS	TOTAL
Car	11.4	2.3	3.3	12.7	6.1	3.5	30.3	5.3	74.7
Motorbike	0.1	---	---	---	---	---	0.1	---	0.3
Bicycle	0.1	---	0.4	0.1	---	---	0.7	---	1.4
Lt.Truck	1.2	0.6	0.1	0.8	0.3	0.3	2.2	0.3	5.8
Hvy.Truck	0.1	0.1	---	---	---	---	0.1	---	0.3
Special Bus	---	---	---	---	---	---	0.1	---	0.2
School Bus	---	---	0.3	---	---	---	0.3	---	0.6
Taxi	---	---	---	0.1	---	---	0.1	---	0.3
Walk	0.6	0.1	2.4	0.9	0.6	0.2	4.2	0.1	9.0
Bus	1.6	---	1.0	0.6	0.5	0.3	3.4	---	7.4
Total	15.1	3.0	7.6	15.2	7.5	4.3	41.6	5.7	100.0

TABLE 7
PRELIMINARY RESULTS
1985 METROPOLITAN VANCOUVER ORIGIN-DESTINATION SURVEY

	24 HOURS	EARLY AM 00:01-06:45	AM PEAK 06:46-09:15	MID DAY 09:16-15:30	PM PEAK 15:31-18:00	EVENING 18:01-24:00
Extent of Travel:						
% of total daily travel	100%	4%	20%	36%	20%	20%
Modal Shares:						
% of travel by automobile	81	87	73	77	84	93
% by transit, school bus	8	10	11	8	10	3
% by walk and bicycle	10	3	16	14	6	3
Travel Purpose:						
To Work 1	15	65	43	7	3	2
2	84/11/5	85/12/3	84/12/5	84/8/6	82/9/9	91/4/5
During Work	3	1	2	6	1	1
	97/1/2	95/2/2	98/1/1	97/1/2	95/2/3	98/1/1
To School	8	3	30	2	1	1
	46/17/37	62/33/5	41/18/41	59/17/14	79/18/3	89/5/4
To Leisure	15	5	7	15	15	27
	89/4/6	93/2/5	89/4/7	85/6/9	90/4/6	94/2/4
To Shopping	8	-	1	13	6	6
	85/7/8		85/7/8	82/8/10	89/5/6	96/2/2
To Personal Business	4	1	3	8	3	2
	88/7/5	93/3/4	87/9/4	86/8/6	91/5/4	97/1/1
To Return Home	42	22	6	43	65	57
	79/9/12	93/3/3	91/2/7	67/11/22	81/12/7	92/4/4
Other	6	1	8	5	6	5
	98/-/1	100/-/-	98/1/1	98/-/-	99/-/-	99/-/-
Distribution of Travel:						
% of automobile trips that began and end in same municipality	60	36	56	66	58	63
% of transit, etc.	59	35	58	68	54	66

1 Columns sum to 100%, apart from rounding

2 Automobile+Truck+Motorcycle+Taxi/Transit+School Bus/Walk+Bicycle

TABLE 8

09/04/87 Trip Purpose Distribution by Arrival Time Page 1

		Home	Work	Home	School	Home	Lei/Fam	Home	Shop/PB	Home	Ser/Pass	Work	Others		
Time	Unknown	Work	Home	School	Home	Lei/Fam	Home	Shop/PB	Home	Ser/Pass	Home	Others	Work	NHWB	Total
0	80	243	2756	0	173	153	5596	59	219	106	366	73	0	847	10671
15	38	93	1528	0	85	0	2385	0	152	60	345	0	0	255	4941
30	155	106	1537	0	103	69	2699	14	118	57	362	66	0	291	5577
45	40	76	727	0	48	0	1271	0	65	0	61	19	0	113	2420
100	132	20	1220	0	20	42	2324	0	17	74	86	20	0	432	4387
115	43	39	622	0	18	0	805	0	27	0	74	14	0	201	1843
130	110	41	223	0	0	0	157	0	0	0	0	26	0	0	557
145	0	0	37	0	0	0	101	0	0	0	27	0	0	0	165
200	96	42	91	0	0	22	17	0	0	0	0	0	0	0	268
215	40	21	32	0	0	0	0	0	0	0	0	0	0	0	93
230	54	42	0	0	0	0	0	19	0	0	0	0	0	18	133
245	0	102	20	0	0	0	17	0	0	0	0	0	0	0	139
300	44	98	35	0	0	0	0	0	0	0	0	77	0	0	254
315	0	96	21	0	45	0	0	0	0	19	0	0	0	0	181
330	0	223	19	0	0	0	0	0	0	0	18	24	0	0	284
345	40	182	47	0	0	0	0	0	0	0	0	0	0	0	269
400	24	340	0	0	0	0	20	0	0	0	15	19	0	21	439
415	45	350	20	0	18	57	0	19	0	28	0	33	0	0	570
430	0	596	57	0	0	19	0	0	0	27	0	0	0	0	699
445	0	516	0	0	0	18	0	0	0	64	0	0	0	0	598
500	0	867	0	0	0	113	0	0	0	36	27	0	0	18	1061
515	18	1190	37	22	0	117	0	0	0	168	0	0	0	17	1569
530	23	2424	24	0	0	291	0	0	0	240	86	0	15	18	3121
545	74	3308	20	154	0	251	0	33	0	264	103	0	22	0	4229
600	155	5184	41	129	0	451	0	71	0	431	234	0	40	19	6755
615	38	7225	43	106	0	349	65	63	0	334	84	18	103	61	8489
630	161	13893	78	676	0	829	115	81	0	1044	243	46	174	70	17410
645	212	18459	79	592	0	950	118	132	0	1132	146	118	325	146	22409
700	669	23588	193	1690	0	1566	268	294	17	1927	512	205	627	133	31714
715	614	28792	133	2625	0	876	264	315	43	2026	413	198	1008	301	37609
730	963	36441	191	6273	0	2095	202	649	76	3896	637	362	1361	509	53660
745	467	38418	151	9459	0	1623	159	807	60	3985	661	305	1835	947	58896
800	781	38664	229	17163	0	3513	525	1790	87	6425	1555	881	2574	1356	75568
815	768	30126	162	15669	33	2554	394	1255	175	5155	1900	860	3499	1891	64441
830	463	25895	225	24233	33	5509	784	1991	263	10383	3139	970	2913	3111	79978
845	159	17922	41	14436	0	4514	1024	1605	240	6467	3853	861	2983	3697	57802
900	365	15332	118	7749	34	7411	1552	7078	515	4003	4063	1593	2133	5013	57009
915	212	8266	123	3265	21	3494	702	3596	546	1060	1801	1247	1095	3079	28507
930	250	6755	217	2232	91	5022	646	7757	1143	1249	877	1740	778	3112	31869
945	113	3688	191	1253	46	2731	319	4138	951	666	355	1494	925	2419	19289
1000	539	4561	377	1472	318	7615	1365	17337	2033	1234	601	2834	809	5063	46158
1015	250	2498	358	1276	126	3672	930	5614	1672	600	378	1614	570	4259	23817
1030	210	2358	297	959	216	4017	2332	8815	4480	587	369	1919	727	6743	34029
1045	189	1667	296	658	63	2402	734	3793	2102	740	156	1118	385	4840	19143
1100	276	2308	654	548	573	5231	2858	11598	6266	1257	450	2369	580	9069	44037
1115	195	1279	425	420	820	3212	1834	4036	2943	1314	959	1509	540	5804	25290
1130	345	1485	763	576	2638	2989	4630	5139	7232	1856	2232	1707	709	10046	42347
1145	268	954	757	446	1058	2487	2685	2145	3777	917	1234	1465	701	7214	26108
1200	500	2183	4398	955	2444	5639	4646	8068	8211	1511	1792	5414	764	10633	57158
1215	486	1264	1185	1208	881	2320	2042	3261	2778	865	1021	1766	861	5636	25574
1230	315	1738	1266	1742	851	3761	2763	3903	5706	1416	1023	1746	1295	8317	35842
1245	267	1501	683	1584	479	1866	1738	1812	2466	1449	771	921	1328	5816	22681

TABLE 8 (Cont'd)

Trip Purpose Distribution by Arrival Time

Time	Unknown	Home Work	Work Home	Home School	School Home	Home Lei/Fam	Lei/Fam Home	Home Shop/PB	Shop/PB Home	Home Ser/Pass	Ser/Pass Home	Work Others	Others Work	NHWB	Total
1300	471	2506	2414	898	615	5631	3392	11176	6395	1454	1132	2074	2478	10545	51181
1315	250	1470	896	365	651	2242	1942	3426	3710	623	836	1321	1296	5610	24638
1330	405	1408	1400	287	535	2379	2799	5577	5699	692	723	1358	1684	7500	32446
1345	257	886	728	257	619	1592	1977	2291	2863	332	482	956	828	5210	19278
1400	255	1770	2300	382	1591	3712	3948	9376	7951	1376	591	2210	1157	9982	47201
1415	173	1156	2249	240	1506	1869	2596	2551	4107	1264	628	1063	483	6835	26725
1430	197	2025	3587	138	5247	3369	4250	4163	7668	2506	1933	1525	1041	11001	49650
1445	119	1853	3130	136	3514	1935	2555	1612	4145	2626	1645	1645	851	7738	33504
1500	477	2591	7760	137	14821	4508	7320	6069	9681	5137	5228	2746	767	14516	81758
1515	209	1974	7397	139	10906	1857	4808	1740	5125	930	4544	2265	760	9614	52268
1530	472	2195	11900	168	8916	3923	5698	4317	8400	1541	2810	3609	807	9726	64502
1545	481	1283	12038	115	5560	2093	3163	1541	4463	1062	1593	2238	497	5503	41675
1600	426	1857	22329	248	5061	5356	6477	5221	10273	2040	2228	4450	690	8207	74863
1615	224	1107	18705	146	4002	2612	4205	1710	5466	1336	2043	3464	346	5244	50610
1630	451	1636	27671	254	3950	4325	7358	2703	8334	1963	3232	4854	416	7129	74276
1645	359	1305	23234	136	2588	2711	4261	1419	5703	1422	2242	3483	411	5053	54332
1700	382	1700	33371	231	2853	6163	7106	4313	8098	2350	3901	5969	360	7624	84421
1715	225	855	25029	166	2451	2819	4628	1222	4659	1075	3244	2696	137	5037	54243
1730	648	1121	24000	413	2179	6718	5597	3991	6652	1672	3376	3102	183	4985	64637
1745	224	659	15248	397	1973	4949	3741	1304	4333	1448	2206	1727	69	3987	42265
1800	333	1156	15698	736	1701	12932	6859	3628	5549	2367	2707	1773	163	5566	61173
1815	164	692	10124	678	1171	7674	3524	1241	2681	1172	2196	1169	161	3016	35663
1830	367	1310	7344	1233	794	13958	5479	4741	3269	1934	1639	908	107	4368	47501
1845	107	1032	4802	1600	706	10073	3105	2202	1975	1503	1371	502	58	2623	31664
1900	224	1460	5526	1531	614	22350	5977	8906	3538	2188	1599	640	208	5029	59789
1915	155	608	3324	578	521	10983	4244	2839	2391	1156	1171	281	34	4119	32403
1930	150	682	2511	357	848	12288	7540	4605	3797	1332	1336	529	77	4625	40678
1945	106	413	1618	78	419	6432	4605	1272	2488	712	1010	147	22	2694	22016
2000	250	538	2330	221	530	10626	10097	3260	5310	1346	1339	273	59	4327	40506
2015	135	236	1330	103	382	3205	5517	807	2723	762	1122	183	20	2625	19150
2030	96	217	1614	56	650	4632	8988	1496	4694	864	1251	372	44	4150	29124
2045	134	280	1248	30	392	1897	5498	497	2525	455	1083	159	27	2034	16259
2100	171	397	3608	0	1212	3430	13198	675	5684	866	1425	314	15	3481	34476
2115	130	117	2341	0	623	1409	5120	240	2591	416	722	211	78	1825	15823
2130	78	318	2742	23	1334	1701	10789	485	3228	488	918	245	62	2487	24839
2145	94	211	1795	0	953	608	6006	212	1718	403	759	105	21	1406	14296
2200	224	300	3135	32	2031	1007	13054	296	1591	720	1024	82	73	2213	25782
2215	119	290	1760	0	1226	523	6914	156	1074	289	777	121	0	1249	14493
2230	59	518	1724	0	785	355	9412	161	1038	363	505	59	36	1534	16549
2245	18	401	1105	0	274	329	4830	87	494	308	774	77	61	689	9457
2300	78	709	3118	0	498	511	10032	79	651	307	760	98	19	1558	18418
2315	59	616	2098	0	464	166	4598	40	245	142	502	116	0	747	9793
2330	41	471	1594	0	189	205	5898	16	317	327	755	97	0	939	10849
2345	108	360	1149	0	167	76	2930	17	182	124	565	81	24	522	6305
Unknown	8247	33812	41023	4616	4885	25899	37076	14072	15931	4797	5564	15579	5776	40047	257324
Sum	21441	398223	352371	132153	109262	287993	303121	220967	237864	118465	105016	96948	48314	326421	2758559

3.3.5 Travel Profile: Trip Distribution

A prime objective the telephone survey was to assist in the specification of trip distribution models. GVRD staff have developed routines to build trip tables from the survey data. The basis of the trip tables can be the individual traffic zones (about 350 zones in total), or various user-specified aggregations of zones, or combinations of zones and (non-overlapping) aggregations. The survey-derived trip tables will be used to derive synthetic matrices by travel purpose.

Using factored data, the GVRD has prepared tables of intermunicipal flows under the following classifications:

(a) by time period

24-hour
AM Peak (6:00-8:59)
PM Peak (15:00-17:59)

(b) by mode

auto drivers
transit passengers
auto drivers + auto passengers + transit passengers

(c) by trip purpose

13 useful trip purposes plus an overall total

The 126 resulting tables (14x3x3) have been compiled in the report, "Intermunicipal Travel Patterns", available from GVRD Development Services[4]. This report provides local planners with insights into such matters as the commuting and shopping patterns of their residents, their extent of transit use, etc. Tables 9, 10 and 11 are examples of the intermunicipal trip tables, being respectively total trip tables (drivers+passengers+transit, all trip purposes) for the AM peak period, and trips tables of transit passengers for the AM peak period and all day.

Traffic-zone-to-traffic zone trip tables have been prepared from the factored survey data(1) for the AM peak hour (7:30-8:29), for the PM peak hour (16:30-17:29) and for the 24-hour period, and in each case for auto drivers (i.e. vehicles) and transit passengers. The 24-hour tables

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(1) Factoring included only the application of sample-to-population expansion factors; it did not include "corrections" for underreporting any other adjustments to the survey results. The trip tables also include results from the external travel surveys, described in Section 5. Overall, travel within the CMA by non-residents is about 4% that of residents.

TABLE 9
1985 AM Peak Period (6:00-9:00) Auto and Transit Origin and Destination Trip Table

To —> From	CBD	Van, NW Burnaby	North Shore	Northeast Sector	Richmond	South of Fraser	External	Total	% Total
CBD	2,492	4,326	295	181	405	197	75	7,971	1.4%
Van,Burnaby,NW	31,506	75,787	5,673	3,453	10,789	5,665	1,625	134,498	24.0%
North Shore	10,509	9,774	12,154	414	851	494	466	34,662	6.2%
NE Sector	4,376	15,035	1,062	10,837	1,255	2,231	1,367	36,163	6.5%
Richmond	4,776	8,706	597	155	10,434	1,091	265	26,024	4.7%
South of Fraser	5,701	17,460	899	1,787	6,563	19,594	2,928	54,932	9.8%
External	872	2,302	468	462	539	3,228	5,265	13,136	2.3%
Work Trip	60,232	133,390	21,148	17,289	30,836	32,500	11,991	307,386	55.0%
% Grand Total	10.8%	23.9%	3.8%	3.1%	5.5%	5.8%	2.1%	55.0%	
CBD	53	767	50	0	27	0	0	897	0.2%
Van,Burnaby,NW	1,187	39,161	668	264	203	190	146	41,819	7.5%
North Shore	183	3,257	8,909	18	0	66	0	12,433	2.2%
NE Sector	216	2,793	54	9,141	55	90	66	12,415	2.2%
Richmond	122	2,367	0	0	4,557	68	46	7,160	1.3%
South of Fraser	174	2,830	47	143	331	15,856	363	19,744	3.5%
External	20	312	20	44	66	502	4,134	5,098	0.9%
School Trip	1,955	51,487	9,748	9,610	5,239	16,772	4,755	99,566	17.8%
% Grand Total	0.3%	9.2%	1.7%	1.7%	0.9%	3.0%	0.9%	17.8%	
CBD	469	1,058	159	56	183	70	21	2,016	0.4%
Van,Burnaby,NW	2,840	34,137	757	1,062	929	926	956	41,607	7.4%
North Shore	968	1,479	9,898	122	109	57	242	12,875	2.3%
NE Sector	228	2,517	64	9,872	135	308	267	13,391	2.4%
Richmond	379	1,677	72	57	5,648	337	204	8,374	1.5%
South of Fraser	397	2,143	70	418	476	20,065	815	24,384	4.4%
External	77	263	270	139	90	890	5,254	6,983	1.2%
Homebased Other	5,358	43,274	11,290	11,726	7,570	22,653	7,759	109,630	19.6%
% Grand Total	1.0%	7.7%	2.0%	2.1%	1.4%	4.1%	1.4%	19.6%	
CBD	991	1,479	149	61	237	102	87	3,106	0.6%
Van,Burnaby,NW	2,604	13,695	603	380	989	889	247	19,407	3.5%
North Shore	660	884	2,751	93	52	52	87	4,579	0.8%
NE Sector	177	986	35	2,373	39	316	153	4,079	0.7%
Richmond	456	911	0	20	1,470	159	163	3,179	0.6%
South of Fraser	83	1,072	109	189	441	4,179	349	6,422	1.1%
External	20	302	31	44	76	191	1,239	1,903	0.3%
Non-Home Based	4,991	19,329	3,678	3,160	3,304	5,888	2,325	42,675	7.6%
% Grand Total	0.9%	3.5%	0.7%	0.6%	0.6%	1.1%	0.4%	7.6%	
Grand Total	72,536	247,480	45,864	41,785	46,949	77,813	26,830	559,257	100.0%

TABLE 10
1985 PM Peak Period (3:00-6:00) Transit Origin and Destination Trip Table

From \ To -->	CBD	Van, NW Burnaby	North Shore	Northeast Sector	Richmond	South of Fraser	External	Total	% Total
CBD	1,125	1,275	73	44	97	0	0	2,614	3.6%
Van,Burnaby,NW	13,796	10,110	538	227	598	353	65	25,687	35.6%
North Shore	3,594	842	1,037	0	0	0	0	5,473	7.6%
NE Sector	1,024	735	0	168	0	39	0	1,966	2.7%
Richmond	1,172	612	32	0	370	0	0	2,186	3.0%
South of Fraser	2,197	1,540	80	0	225	562	70	4,674	6.5%
External	40	23	0	0	0	0	0	63	0.1%
Work Trip	22,948	15,137	1,760	439	1,290	954	135	42,663	59.2%
% Grand Total	31.8%	21.0%	2.4%	0.6%	1.8%	1.3%	0.2%	59.2%	
CBD	52	351	0	0	27	0	0	430	0.6%
Van,Burnaby,NW	790	14,109	223	62	19	59	18	15,280	21.2%
North Shore	103	712	2,070	0	0	14	0	2,899	4.0%
NE Sector	175	406	0	1,804	0	27	0	2,412	3.3%
Richmond	72	666	0	0	740	0	0	1,478	2.1%
South of Fraser	111	841	0	64	35	2,056	23	3,130	4.3%
External	0	0	0	0	0	0	62	62	0.1%
School Trip	1,303	17,085	2,293	1,930	821	2,156	103	25,691	35.7%
% Grand Total	1.8%	23.7%	3.2%	2.7%	1.1%	3.0%	0.1%	35.7%	
CBD	62	95	0	0	0	0	0	157	0.2%
Van,Burnaby,NW	453	1,367	0	0	65	45	22	1,952	2.7%
North Shore	43	28	145	16	0	0	0	232	0.3%
NE Sector	0	0	0	162	0	0	0	162	0.2%
Richmond	17	16	0	0	0	0	0	33	0.0%
South of Fraser	78	170	0	0	34	90	25	397	0.6%
External	0	0	0	0	0	0	0	0	0.0%
Homebased Other	653	1,676	145	178	99	135	47	2,933	4.1%
% Grand Total	0.9%	2.3%	0.2%	0.2%	0.1%	0.2%	0.1%	4.1%	
CBD	52	39	0	0	0	0	0	91	0.1%
Van,Burnaby,NW	124	398	0	0	20	0	0	542	0.8%
North Shore	76	0	22	0	0	0	0	98	0.1%
NE Sector	0	0	0	0	0	0	0	0	0.0%
Richmond	0	0	0	0	0	0	0	0	0.0%
South of Fraser	36	0	0	0	0	0	0	36	0.0%
External	0	0	0	0	0	0	0	0	0.0%
Non-Home Based	288	437	22	0	20	0	0	767	1.1%
% Grand Total	0.4%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	1.1%	
Grand Total	25,192	34,335	4,220	2,547	2,230	3,245	285	72,054	100.0%

TABLE 11
1985 All Day Transit Passenger Origin and Destination Trip Table

To —> From	CBD	Van, NW Burnaby	North Shore	Northeast Sector	Richmond	South of Fraser	External	Total	% Total
CBD	3,017	17,602	3,511	1,552	1,682	2,889	165	30,418	11.6%
Van,Burnaby,NW	18,060	25,949	1,680	1,261	1,361	2,226	143	50,680	19.4%
North Shore	4,226	1,706	2,759	0	51	62	0	8,804	3.4%
NE Sector	1,296	1,220	0	614	0	112	0	3,242	1.2%
Richmond	1,411	1,370	80	0	1,446	215	0	4,522	1.7%
South of Fraser	2,495	2,245	112	91	285	2,060	90	7,378	2.8%
External	40	102	0	0	0	53	0	195	0.1%
Work Trip	30,545	50,194	8,142	3,518	4,825	7,617	398	105,239	40.2%
% Grand Total	11.7%	19.2%	3.1%	1.3%	1.8%	2.9%	0.2%	40.2%	
CBD	81	1,637	90	178	153	91	0	2,230	0.9%
Van,Burnaby,NW	1,820	36,574	1,168	928	787	1,176	18	42,471	16.2%
North Shore	144	974	4,563	17	0	14	0	5,712	2.2%
NE Sector	175	848	0	4,373	0	38	0	5,434	2.1%
Richmond	106	789	0	0	1,607	51	0	2,553	1.0%
South of Fraser	111	960	14	89	69	4,582	43	5,868	2.2%
External	0	0	0	0	0	0	146	146	0.1%
School Trip	2,437	41,782	5,835	5,585	2,616	5,952	207	64,414	24.6%
% Grand Total	0.9%	16.0%	2.2%	2.1%	1.0%	2.3%	0.1%	24.6%	
CBD	4,206	10,383	934	184	276	606	0	16,589	6.3%
Van,Burnaby,NW	9,706	28,502	455	808	505	965	227	41,168	15.7%
North Shore	673	469	4,159	16	0	75	0	5,392	2.1%
NE Sector	180	736	0	1,530	20	0	0	2,466	0.9%
Richmond	293	450	0	20	1,611	119	0	2,493	1.0%
South of Fraser	426	1,234	34	0	116	3,435	107	5,352	2.0%
External	0	24	20	0	0	92	20	156	0.1%
Homebased Other	15,484	41,798	5,602	2,558	2,528	5,292	354	73,616	28.2%
% Grand Total	5.9%	16.0%	2.1%	1.0%	1.0%	2.0%	0.1%	28.2%	
CBD	1,573	2,593	412	80	149	177	0	4,984	1.9%
Van,Burnaby,NW	3,049	6,246	117	188	243	264	32	10,139	3.9%
North Shore	284	86	974	0	16	0	0	1,360	0.5%
NE Sector	16	131	0	315	0	31	0	493	0.2%
Richmond	68	99	0	0	186	0	0	353	0.1%
South of Fraser	161	111	0	0	21	467	0	760	0.3%
External	22	18	0	0	32	45	0	117	0.0%
Non-Home Based	5,173	9,284	1,503	583	647	984	32	18,206	7.0%
% Grand Total	2.0%	3.6%	0.6%	0.2%	0.2%	0.4%	0.0%	7.0%	
Grand Total	53,639	143,058	21,082	12,244	10,616	19,845	991	261,475	100.0%

were assigned to the network of the GVRD's transportation model on an "all-or-nothing" basis; the peak hour tables were assigned on an equilibrium assignment basis. Results of the assignments in the form of screenline crossings were then compared with actual 1985 ground counts for the screenlines.

The following points were noted:

(a) The "all or nothing" 24-hour assignments could not be expected to provide reliable link-specific volumes, but on an overall screenline basis would compare well with screenline totals if the survey data was close to being perfect. As it turned out, the "all day" survey results did not compare that favourably with the observed volumes, being overall about 20% below "actuals." On the one hand, commercial or business-related travel is not included in the survey results but is included in the actual screenline counts. On the other hand, some under-reporting of travel appears to be indicated.

(b) In contrast to the 24-hour results, the comparisons of assigned AM peak and PM peak auto volumes to actual screenline counts show much better correspondence. In fact, in some instances, the travel reported in the survey "exceeds" the observed travel.

(c) The results of the 24-hour transit assignment showed good correspondence with the observed screenline totals, generally slightly under the actuals. The AM-peak and PM-peak hour transit assignments correspond closely with the actual counts, in some cases being higher than the actuals.

In light of these results, the following explanations are reasonable:

(a) Good results might have been expected for the AM peak. Personal travel dominates the AM peak hour such that (unsurveyed) commercial or business related travel volumes may not be significant. Also, trips in the AM peak are typically habitual and are known to and easily remembered by all members of the household.

(b) The results suggest that peak travel, and travel by transit at all times of day, may not have been underreported to any great degree in the telephone survey.

(c) A comparison is presented in the next chapter between per household trip rates derived from the telephone survey and those derived from the trip diary survey. These results reinforce the above finding by suggesting that "important" trips (such as to work or to school) have not been underreported in the telephone survey.

(d) The results did suggest that there is a need to apply so-called "time-space" procedures in using the survey data for regional peak hour modelling(1). Comparison of assigned versus observed totals after application of the GVRD's "time-space" adjustment procedures showed improved correspondence.

(e) Overall, the results point to a minimal need to adjust or correct the results of the telephone survey for AM peak modelling. Such adjustments may be more necessary for other time periods, but it can also be noted that these time periods are less critical in terms of setting capacity requirements.

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(1) The GVRD model's assignment procedures essentially assume that a trip that is loaded onto the network "exists" over the entire length of its path at the same time. The assigned trip thus would be counted in the assignment's screenline totals for each screenline along the trajectory. In actual fact, not all trips beginning in any given (peak) hour can be completed within the peak hour. Consider, for example, a trip to work in the morning peak from an outer suburb to the CBD. The actual trip would not "show up" on the screenline totals for interior screenlines. Without "time-space" adjustment, an otherwise perfect assignment based on departure times would overestimate the volumes on links close to the CBD.

4.0 TRIP DIARY

4.1 Designing and Contracting for the Trip Diary

4.1.1 Survey Objectives

In his design for the Origin-Destination Survey, Dr. Steuart had proposed that a subset of the larger sample of households assembled for the telephone interview survey be interviewed in depth by means of a travel diary. The diary format would serve several important functions:

(a) More detailed information about persons and households making trips can assist trip generation and mode split analysis using disaggregate analysis methods as well as cross-classification and category techniques. Obtaining such information via the telephone survey would prolong the interviews, and some questions might be felt to be "too personal" and lead to higher refusal rates.

(b) The trip diary results might help to identify underreporting or other biases in the telephone survey results.

(c) The diary results would provide insight into the relationships between the activities of household members and their transportation decisions, potentially helpful in anticipating the effects of changing family and economic conditions. "Day of the week" and weekend variations in travel might also be measured, considering that the telephone survey results were "homogenized" to represent a typical weekday.

4.1.2 Survey Design

As the advisory committee was considering the design of the telephone survey, they were deliberating on the content and format of the trip diary. Agreement was reached on the personal, household and trip-related data to be obtained and preferred interview procedures. On this basis, preliminary estimates were prepared for the likely costs of conducting the trip diary survey and for initial processing of the data (ie. coding, editing, data entry).

Dr. John Claxton, a professor at the University of British Columbia and a principal in a market research firm, was invited to prepare a proposal for carrying out all stages of the trip diary survey. Within the committee's guidelines, the consultant was to take charge of all aspects of the survey including hiring and training staff, arrangements for printing of forms and contact letters, coding and entry of data.

The feasibility study had proposed that a five-day diary format be adopted. In August, a pre-test was conducted using both three-day and seven-day diaries. The test subjects included shoppers at two suburban malls as well as members of the project committee and GVRD staff. The pre-test results contributed to the decision to use the three-day format. Nevertheless, so as to obtain data which would span all seven days, the decision was taken to use three "sets" of three-day diaries. That is, in the instructions accompanying the diaries, the household would be requested to provide travel data either for a Monday-Tuesday-Wednesday period, or for a Wednesday-Thursday-Friday period, or for a Friday-Saturday-Sunday period. Thus Wednesdays and Fridays would overlap.

The pretest results also helped to refine the diary's format prior to final drafting of the forms. Appendix C.2 presents the forms used in the diary survey. The personal data questionnaire form and 22 trip sheets were bound into a booklet. A household's package included one household questionnaire form, one diary booklet per person, and some explanatory material.

4.2 Data Collection and Coding Activities

Data collection began in mid-September. A master sample of 5000 households was obtained from the same sample file as that for the telephone survey. This file was broken down into the three lots and into ten groups corresponding to the ten weeks of data collection activity.

The procedure was to make initial contact with the households by letter to explain the purpose of the survey and what would be required. A member of the survey team would then phone the household to determine whether they would participate and to determine the number of persons in the household. Appropriate numbers of surveys forms were mailed to willing households a week in advance of the requested starting date. A thank-you note was mailed to households returning completed diaries and, as they had been promised, the household was entered into a draw for one of ten family passes for the up-coming EXPO '86.

The data collection, editing and coding was carried out by a team of five, including a team leader. The daily routine consisted of: calling households to see if they would participate; mailing out diary packages; reminder calls to households on the eve of their three-day period; reminder and follow-up calls to determine why households had not yet returned their diaries; preparation and mailing of "thank you" letters to households returning diaries; initial checks of returned packages to determine whether the appropriate number of diaries had been returned, plus follow-up action; detailed examination of the diaries including editing and coding of all fields; insertion of linking data (described below); and, batching of edited and coded diaries for data entry at the keypunching firm.

As with the telephone survey data, a key structure was established building on household number, the person number, the day number and the trip number. For the diary survey, it was necessary for the coding team to add the specifications needed to link the data files. Specifically, it was necessary to manually enter the household code number into each person record. Similarly, the household and person keys were manually entered onto the trip sheet for each person's trips.

As Appendix C.2 shows, the form used to describe each trip essentially calls for the destination to be described. Not shown is a one-page "header form" on which the respondent was asked to describe the origin of the first trip for each of the three days of the diary. Two notions were operative here. First, it was considered that origin descriptions could usually be patched down from the destination descriptions of the preceding trips such that it would usually be unnecessary to explicitly describe each origin. Secondly, while the diary booklet could have been "formally" divided into three sections with the respondent being invited to complete a separate section for each day's travel, it was felt that too many instances would arise where there were, for example, too many forms provided for Day One travel, but not enough for Day Two; instead, by using a header form and by not allocating forms to a specific day, the 22 forms that were provided in the diary booklet, it was felt, would be enough in total to cover the three days. Nevertheless, the chosen method did require that "linking data" on each day's initial trip origin had to be manually inserted onto the trip form for the initial trip.

Overall, the editing and coding procedures that were required prior to key-punching were cumbersome. Coders were required to "flip" back and forth in the diary booklet. In addition to writing in linking data (i.e. key codes) and initial trip origin data on the trip forms, coders were required to transcribe the responses into the left-hand margin due to the keypunchers' difficulty in scanning the trip forms. In the main, these problems were imposed upon the survey contractor as a consequence of the scope and complexity of the data being requested by the client group. A truism that bears repeating, therefore, is that careful attention to the problems that will likely be faced by editors, coders and keypunchers will payoff when designing the format and content of any survey form.

4.3 Diary Results

4.3.1 Overall Returns

Over the course of the 10-week data collection period, 3220 households were contacted and requested to complete diaries. About 80% indicated that they would participate in the survey, but the final total for completions was 1704 households for a 53% completion rate. These households returned 3709 diaries and provided data on 37,086 trips. Table 12 charts the progress of the trip diary survey.

TABLE 12
Trip Diary Survey Progress

	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10
Preliminary Sample List	340	341	341	341	341	341	341	341	341	352
Not Qualified	17	24	21	20	12	22	30	25	20	16
INITIAL SAMPLE	323	317	320	321	329	319	311	316	321	332
DIARIES RETURNED	190	162	168	175	178	174	170	167	155	153
PERCENT RETURNED	58.8	51.0	52.5	54.5	54.0	54.5	54.5	52.8	48.2	48.0

Appendix D describes the structure of the data base containing the results of the diary survey.

The trip diaries were to be completed by or for all household members aged six or older. In the 1704 households, a total of 328 children under six were reported. The total number of reported persons in the surveyed households was 4482; the average size household was 2.63 persons. Based on the reported household sizes and numbers of children under six, it appears that 445 persons who should have completed diaries did not in fact do so (4482 - 3709 - 328 = 445).

Respondents were asked to indicate whether a child under six accompanied them on each trip. Overlooking the potential for double counting - for example, when both the mother and the father travelling together each reported that they were accompanied by a child - there were 1842 instances reported where there was one accompanying child, 681 instances of two accompanying children, 85 instances of three children, 23 with four, 7 with five, 1 with six and 12 with seven. Not all of these children would have been members of the surveyed families.

4.3.2 Use of Diary Results to Validate Telephone Survey Results

4.3.2.1 Comparison of the Two Samples with the Population

The most important purpose for conducting the diary survey was to provide a basis for validating or adjusting the results of the telephone interview survey. The comparisons between the results of the two surveys are in some cases befuddled, however, by differences in the survey methods or by definitions or coding and editing procedures embodied in the surveys. The more important differences include the following:

(a) Diary results were dominantly "self reported." In the telephone survey, travel details for a particular household member may have been provided by another household member. Those who "report for others" may not be aware of or remember all the details of the other's travel.

(b) Detailed information about the trip-making of young children was not obtained in the diary survey. As a crude correction, the 3709 persons who reported on 37,086 trips also indicated that a total of 3676 young children accompanied them on those trips. Thus, overall reported trip rates per household might be factored up by 10% to account for trip making by young children. Clearly, however, this adjustment would not apply to all trip purposes or times of day, a notable example being the trip to work.

(c) Diaries were not returned by 445 persons who evidently should have returned them. Coupled with the incomplete measure of travel by young children, the diary results do not provide a complete picture of travel in the sampled households. Similarly, the characteristics of the "non-responders" (age, sex, income, etc.) are not known. For example, the question arises: are non-responders similar to those who did complete diaries? Did they not respond because they had no trips to report? Were they too busy travelling?

(d) The editing and coding procedures of the telephone survey, together with the call back procedures, ensured that missing data was kept to a minimum. Also, distinctions were made between missing data - which were assigned special codes - and null responses. The diary survey results, however, contain numerous instances of missing specifications. This creates a dilemma in distinguishing between null responses and non-responses. To give an example, consider the responses to the question about the number of children under six who accompanied the reporter on the particular trip:

there were over 2570 instances of missing specifications among the 37,086 reported trips. It is fairly likely that most of the 2570 instances arose because the reporters felt the question did not apply to them - i.e. there were no young children along on the trip. Nevertheless, an outright assignment of the non-responses to the null category must understate somewhat the trip rates of young children, while ignoring the non-responses must somewhat overstate their travel. In this and other situations, judgment and intuition can be applied but the "true" value of the specific index will not be precisely known.

(e) Telephone survey results have been "homogenized" to derive a description of "typical weekday" travel. Although diary results could also be homogenized, they were found to be sensitive to the "Day of Week" and "Day of Diary" for which the data was provided.

In view of the above problems, the first steps in the analysis of the diary results have been to attempt to confirm the representativeness of the diary sample in relation to the telephone survey sample and the general population, and to attempt to identify the adjustments that would be required in order to use diary results as standard or basis against which telephone survey results might be compared. The following sections present comparisons of the telephone interview and trip diary results relative to the overall CMA population, reported trip making behaviour and mode choice considerations.

4.3.2.2 Comparison to the CMA Population

(i) Household Size

Table 13 compares the household size profile of the telephone survey and trip diary respondents with that of overall CMA population.

TABLE 13
PERCENT OF HOUSEHOLDS BY HOUSEHOLD SIZE

HOUSEHOLD SIZE	DIARY RESULTS	TELEPHONE SURVEY	VANCOUVER CMA (1981 CENSUS)
1	21.6	22.0	26.9
2	36.4	33.6	31.1
3	16.0	16.5	15.2
4	15.5	17.7	15.8
5	6.5	7.2	7.0
6	2.8	2.1	2.6
7	0.6	0.6	0.7
8+	0.6	0.4	0.6
Avg. Household Size	2.63	2.69	2.66

A simple statistical test (the Chi-squared test) establishes a high level of confidence that the sampled proportions by household size are not significantly different from those we would expect to observe in the population. Notwithstanding, the proportion of one-person households is appreciably lower in the (1985) samples than in the 1981 population. It may be that the economic recession through which Greater Vancouver suffered between 1981 and 1985 led to increased "doubling up" or moving back in with parents. In the case of the telephone survey, one would expect some under-representation in one-person households.

(ii) Workers per Household

The diary results add together the specifications of full-time and part-time workers so as to be consistent with the telephone survey. No corresponding profile of the CMA's population is available from Census or other sources. As shown in Table 14, a high "goodness of fit" is observed between the two survey samples.

TABLE 14
NUMBER OF WORKERS PER HOUSEHOLD

NUMBER	DIARY RESULTS	TELEPHONE SURVEY
0	22.7%	23.6%
1	35.8%	37.9%
2	31.5%	30.2%
3	6.5%	6.0%
4	2.7%	1.8%
5+	0.8%	0.5%

(iii) Vehicles per Household

The telephone survey asked respondents to indicate the number of vehicles available to the household for personal use, with motorcycles and scooters being included as a vehicle in the total. The diary survey asked respondents to indicate both the number of vehicles and the number of motorcycles in the household. This created an ambiguity in that some responses may have included the motorcycles in the vehicle total, while others would have, in effect, assumed that a motorcycle was not meant to be considered as a vehicle. Accordingly, in Table 15 below the A tabulation provides the responses to the diary question, "How many vehicles?" In the B tabulations, the responses to the diary's "motorcycle question" have been added to those of the "vehicle question." Overall, a high "goodness of fit" is observed between the two samples, using the more reliable telephone survey results as the "expected" profile. No profile of the CMA's vehicles per household is available from Census or other sources.

TABLE 15
NUMBER OF VEHICLES PER HOUSEHOLD

NUMBER	DIARY RESULTS		TELEPHONE SURVEY
	A	B	
0	9.4%	10.1%	12.2%
1	40.1%	38.4%	39.7%
2	39.0%	36.7%	35.4%
3	9.0%	11.1%	9.3%
4	2.3%	2.4%	2.4%
5+	0.3%	1.5%	0.8%

(iv) Age Profile

The telephone survey specifically identified the age of each respondent. (Pronounced modalities at the five-and ten-year marks - especially at the 65-year-old mark - suggests some amount of intentional inaccuracy on the part of the respondents, however.) The diary survey and the Census both used age-group categories, but the age group categories were not identical. Thus, although the diary survey was meant to validate the telephone survey, it was in fact necessary to affirm the representativeness of the telephone survey's age profile in relation to that of the CMA population (see Table 4), and then to affirm the similarity of age group profiles of the diary and telephone survey results.

(v) Municipalities of Residence of Sampled Households

TABLE 16
HOME LOCATIONS OF SAMPLED HOUSEHOLDS

Municipality	Diary Results		Telephone Survey		1986 Census	
	Number	%	Number	%	Number	%
Belcarra	2	0.1	26	0.1	194	0.0
Burnby	199	11.8	2,791	11.1	58,492	11.0
Coquitlam	78	4.6	1,232	4.9	24,177	4.5
Delta	111	6.6	1,379	5.5	25,010	4.7
Lions Bay	1	0.1	15	0.1	378	0.1
New Westminster	47	2.8	810	3.2	19,421	3.6
N. Vancouver City & District	133	7.9	2,076	8.2	40,607	7.6
Port Coquitlam	30	1.8	522	2.1	9,325	1.7
Port Moody	15	0.9	262	1.0	5,404	1.0
Richmond	118	7.0	1,809	7.2	38,165	7.2
Surrey	211	12.5	2,975	11.8	61,831	11.6
Vancouver	537	31.9	8,254	32.8	187,233	35.1
West Vancouver	41	2.4	749	3.0	15,096	2.8
White Rock	17	1.0	365	1.4	6,985	1.3
Other CMA	145	8.6	1,920	7.6	40,925	7.7
Unknown	19					
TOTAL	1,704	100.0	25,185	100.0	533,247	100.0

A high "goodness of fit" is demonstrated between the profiles of the two samples and those of the CMA as determined in the 1986 Census. The actual numbers of surveyed households by municipality is indicated so that potential users of the data base may see the size of the sample they might draw on for their particular applications. Note that, with the telephone survey results, expansion factors have been calculated on a traffic-zone-by-traffic-zone basis and have been inserted into the data records. There is no intention to use the trip diary data except on a disaggregate basis. Accordingly, expansion factors for diary results have not been calculated.

In overview, the above results demonstrate that the profiles of the sampled households are effectively identical in both the trip diary and telephone interview surveys, and that the samples are representative of the population of the Vancouver CMA.

The municipalities in which the homes of sampled households are located can be compared as shown in Table 16.

4.3.2.3 Comparison of Reported Trip Making

(i) Time of Day

After compressing trip departure times reported in the two surveys into five broad time bands, the results compare as shown in Table 17 below.

TABLE 17
REPORTED DEPARTURE TIME

TIME PERIOD		DIARY RESULTS	TELEPHONE SURVEY
Early Morning	**0:01 - 06:45**	3.8%	4.1%
AM Peak	**06:46 - 09:15**	15.9%	20.5%
Mid Day	**09:16 - 15:30**	41.5%	36.2%
AM Peak	**15:31 - 18:00**	20.1%	20.4%
Evening	**18:01 - 24:00**	18.7%	18.9%

A more thorough response was expected via the trip diary survey compared with the telephone survey. For one thing, diary results are, with few exceptions, self-reported whereas "reporting for others" was common and accepted in the telephone survey. (Trips made away from home by other household members - especially during midday - might not be known by the person providing information in the telephone survey.) The conditions for recording or recalling trips also favour higher trip rates being reported via the diary. The above results pointing to the relatively greater incidence of midday trip making in the diary results bear out these expectations.

(ii) Trip Purpose

The categories by which respondents could report each trip purpose were not identical in the telephone and diary surveys. However after combining the categories and normalizing to a common basis, the comparison can be made as shown in Table 18.

TABLE 18
TRIP PURPOSE

PURPOSE	DIARY RESULTS		TELEPHONE SURVEY
to work	12.0		15.1
during work	3.4		3.0
to school	5.9		7.6
to leisure	10.7)	14.3	15.2
to eat out	3.6)		
to shopping	11.6		7.5
to personal business	8.8		4.3
to home	37.7		41.6
to serve passengers	5.3		5.7

It was expected that the telephone survey would be conducive to capturing data on "important" trip purposes. These trips, such as going to and from work or school, would be easily remembered or would be familiar to other household members providing the information. The above results bear these expectations out. Notable are the higher proportions of shopping and personal business trips in the diary results and the corresponding lower proportions of trips to school, to work and to home. These results also reinforce the time-of-day results noted above, wherein the greater proportion of "diary trips" that were midday may have been shopping or personal business trips.

(iii) Mode of Travel

Differences in questionnaire format inhibit a direct comparison of the mode choice and mode frequency results of the two surveys. For example, the walking components of trips being reported in the telephone survey - for example, walking to or from the bus station or the parking lot - were not recorded; in the diary results, there was no control on how or whether respondents included the walking component of their trips. The results in Table 19 therefore compare only "vehicular" mode use proportions of the two surveys (i.e. auto driver, auto passenger and transit passenger):

TABLE 19
VEHICULAR MODE CHOICE

MODE	DIARY RESULTS	TELEPHONE SURVEY
Auto Driver	72.2%	66.5%
Auto Passenger	20.0%	24.6%
Transit Passenger	7.8%	8.9%

It should be noted that the diary results described here have not included the effect of trip making by children under six years of age, for whom no diaries were completed. The effect of including their trip making would be to raise the diary's proportions of auto passengers and transit passengers. Notwithstanding the problems of making a direct comparison, the results of the two surveys seem to point to similar vehicular use tendencies between the two samples.

(iv) Destinations

The results of the diary survey were not meant to provide precise or detailed origin-destination patterns or trip tables. Accordingly, there is no intention to geo-code the origins and destinations of trips reported in the diaries. However, the destinations of trips reported in the diary could usually be identified by municipality, allowing for the comparisons with the telephone survey results as shown in Table 20. The results show high "goodness of fit" between the two surveys.

TABLE 20
MUNICIPAL DESTINATIONS OF SAMPLED HOUSEHOLDS

MUNICIPALITY OF DESTINATION	%(DIARY)	%(TELEPHONE)
Belcarra	-	-
Burnaby	9.9	10.3
Coquitlam	4.2	5.1
Delta	5.2	5.5
Lions Bay	-	-
New Westminster	3.2	3.0
North Vancouver City & Dist	7.0	7.6
Port Coquitlam	1.7	2.1
Port Moody	0.6	1.0
Richmond	8.6	8.6
Surrey	11.8	11.7
U.E.L.	1.6	1.1
Vancouver	33.4	31.9
West Vancouver	2.3	2.9
White Rock	1.3	1.1
Langley City & District	5.6	4.4
Maple Ridge & Pitt Meadows	2.5	3.0
East - South of Fraser	0.4	0.2
East - North of Fraser	0.1	0.1
Elsewhere	0.5	0.3

(v) Comparison of Trip Rates

An important application of the diary survey results is to validate or adjust the results of the telephone survey in matters of trip generation and mode choice. A first requirement, therefore, was to verify that the diary results were themselves reliable, internally consistent and free of contaminating effects resulting from the diary's sampling or data collection methods.

One of the first investigations was to determine whether trip rates reported in the diary were sensitive to the municipality of residence of the household. If it was determined, for example, that per person or per household trip rates were significantly different among municipalities, subsequent analysis might have to be stratified along the municipal "dimension" rather than treating the sample as homogenous. Analysis of variance techniques indicated no significant differences among the reported three-day per person or per household trip rates based on municipality. Multiple regression analysis confirmed this finding: reported trips per household (the dependent variable) were sensitive to the size, number of vehicles and employed persons of the household but not sensitive to the household's municipality of residence.

A common phenomenon in diary research is what might be called a "diligence fall off" when respondents or test subjects become less keen and less thorough in their reporting as the experiment or measurement period progresses. Indeed, this phenomenon had been observed in the diary pre-testing and had contributed to the choice of a three-day diary format over a seven-day format. Nevertheless, it was appropriate to investigate whether the phenomenom of "diligence fall off" was manifest in the three-day reporting.

The three sets of diary forms used in the survey - namely, requesting households to provide travel data for the M-T-W period or for the W-T-F period, or for the F-S-S period - "overlapped" on Wednesdays and Fridays. That is, on these two days, some households would be completing Day 3 of their diaries while others would be completing Day 1. Regression-based analysis isolating Wednesday and Friday travel showed the following

Household Trips per Day on Wednesdays = 0.86 + 0.90 x Number of vehicles
+ 1.74 x Number in household
+ 0.69 x Full-time employed
- 0.64 if Day 3

Household Trips per Day on Fridays = 0.90 + 1.08 x Number of vehicles
+ 2.10 x Number in household
+ 0.52 x Full-time employed
- 0.59 if Day 3

Thus there appeared to be a fall off of about 0.6 trips per household per day in the reported trip rates of Day 3 of the diary. Further, more detailed analysis of the fall off could not isolate any trip type or time period to which the fall off would be most attributable.

The above analysis identified the need to account for "Day of Week" and "Day of Diary" effects when using the results of the trip diary. Regression-based analysis was undertaken to isolate these effects as follows:

Household trips per day (across all days) = 0.57 + 0.98 x Number of vehicles
+ 1.82 x Number in household
+ 0.57 x Full-time employed
- 1.02 if Monday
+ 1.16 if Friday
- 1.42 if Sunday
- 0.57 if Day 3

No significant fall off in reported trip rates per household for Day 2 of the diary compared with Day 1 was identified after adjusting for Day of Week effects. Household trip rates per day were approximately the same for Tuesdays, Wednesdays, Thursdays and Saturdays. Compared with this level, households made approximately one less trip on Mondays, one more trip on Fridays and one and one-half fewer trips on Sundays. These results suggest that the closest basis of comparison between trip diary results and those of the telephone survey would be obtained by first selecting a sub-set of the diary results which correspond to Day 1 and Day 2 reporting for Tuesday, Wednesday and Thursday.

Further analysis was done to isolate so-called "method effects." As noted before, the telephone survey obtained some "self-reported" trip data and some "reported by others" data; the diary survey results were "self reported" but did not include children under six years of age and did not include data on non-responding persons.

Using a subset of the telephone survey results, an attempt was made to distinguish "self reported" from "reported by others" data. A subset of diary results was drawn, including only Day 1 records for weekdays.

As shown in Table 21 averages of trips per person per day showed clear differences in the trip rates reported in the three samples. In the telephone survey, "self reporters" averaged 3.3 trips per person per day while "reported by others" averaged 2.6 trips per person per day. The overall average in the telephone survey was 2.9 trips per person per day. In the diary results, "self reporters" averaged 3.5 trips per person per day.

TABLE 21
REPORTED TRIP RATES PER PERSON

AGE OF RESPONDENT	DIARY		TELEPHONE "SELF"		TELEPHONE "OTHER"	
	M	F	M	F	M	F
13-19	3.45	3.40	n/a	n/a	2.85	2.75
20-29	3.60	3.80	3.55	3.90	2.85	2.70
30-39	4.05	4.15	3.80	3.95	3.05	2.90
40-49	3.60	3.80	3.85	3.95	3.05	2.45
50-64	2.75	3.45	3.30	2.95	2.60	2.05
65+	2.05	2.65	2.45	2.20	2.05	2.00

Travel by children under six was not included in the above diary results. Also, it can be demonstrated that a high proportion of "reported by others" results in the telephone survey pertain to children. Given the lower trip rates of children, these differences in sampling method must certainly give rise to the differences in overall trips-per-person averages. (Refer to Table 5 in Section 3 for a profile of reported trip rates by age). To control for the age/demographic effects and to isolate the "method effects," further regression based analysis was undertaken according to the following model:

An Individual's Trips per day is a function of:

a constant + Method Effects + Vehicle Effects + Age Effects + Day-of-the-week Effects + Activity Pattern Effects

The method effects were as follows:

- 0.69 trips per day when the data was telephone 'others.'
- 0.40 trips per day when the respondent was a man of 40+ years reporting in a diary.
- 0.25 trips per day when the respondent was a woman of 50+ years reporting for herself on the telephone.

In other words, there was a general pattern of under-reporting the trips of 'others' on the telephone. In addition, there were demographic-method interactions in that older men seemed to be less diligent on the telephone. These findings were all statistically significant. As results presented in the previous chapter suggest, the under-reporting in the telephone survey seems mainly to be related to off-peak and non-home-based trips.

4.4 Application of the Trip Diary Results

The initial investigations of the diary results have confirmed the representativeness of the sample and have indicated the provisos and adjustments that are required when using the results or when comparing them to the results of the telephone survey. As outlined in Appendix D, the diary survey results have been mounted into data bases resident at the GVRD. These data bases may be "dialled up" by local clients or may be downloaded and made available to interested parties in other areas.

4.4.1 Preliminary Trip Generation Analysis

One important application of the diary results is to measure trip generation rates. Using the diary data, per household per day generation rates have been determined for sixty different household categories, seven different trip purposes, six different times of day, and for six (groupings of) days of the week. The categories, etc. are as follows:

Household Categories: 60 categories total being combinations of

Household size: 1, 2, 3, 4, 5 or more
Full-time employed: 0, 1, 2 or more
Vehicles in household: 0, 1, 2, 3 or more

Trip Purpose Categories (7 categories)

Home to work and Work to home	(HBW)
Home to shopping and Shopping to home	(HBShopping)
Home to school and School to home	(HBSchool)
Home to other and Other to home	(HBOther)
Other to other	(NHB)
Unspecified, Missing	
Total, all purposes	

Time of Day Categories

Early Morning: 00:00 - 06:45
AM Peak: 06:46 - 09:15
Midday: 09:16 - 15:30
PM Peak: 15:31 - 18:00
Evening: 18:01 - 24:00

Total, all day

Days of Week: 6 categories

Monday
Tuesday
Wednesday and Thursday
Friday
Saturday
Sunday

Trips by bicycle, walking or other non-vehicular modes are excluded in the tables that were produced. Also, since initial analysis showed Day3 data to be suspect, Day 3 data pertaining to Wednesdays and Fridays has been excluded. Regarding trip purpose, the diary allowed for the specification of eleven "to" purposes (e.g. to work, to shop, to home).Subsequent processing of the results was made to identify the type of origin of each trip, leading to 121 possible "from-to" categories (11 x 11), which were then combined to derive the seven indicated categories. Note that the various "total" tabulations (e.g. all-day, all purposes) include data from travel records with incomplete opecifications.

Since over 100 tables are required to present the various combinations of categories, all these tables cannot be presented in this report. They can be made available by writinq to GVRD Development Services.

Tables 22 and 23 compare, respectively, AM peak-period and 24-hour per household trip generation rates for selected household categories derived from the diary survey and from the telephone interview survey. It should be noted that while the diary data pertains to Wednesdays and Thursdays the telephone results are "homogenizations" of the five weekdays. Moreover small sample sizes of some of the diary results could give rise to high sampling error. Accepting these caveats, the following observations can be made:

TABLE 22
COMPARISON OF TRIP RATES FROM DIARY AND TELEPHONE INTERVIEW SURVEYS
(AM PEAK 6:00-8:59)

HOUSEHOLD CATEGORY[1]			TRIP PURPOSE									
			HB[2]WORK		HB EDUCATION		HB OTHERS		NHB		TOTAL	
P	W	A	D[3]	T[3]	D	T	D	T	D	T	D	T
1+	0	0	0.000	0.002	0.146	0.040	0.042	0.021	0.000	0.002	0.188	0.065
1+	1+	0	0.500	0.409	0.071	0.072	0.071	0.038	0.036	0.014	0.679	0.533
1	0	1+	0.028	0.006	0.028	0.029	0.056	0.037	0.000	0.004	0.111	0.076
1	1	1+	0.375	0.550	0.000	0.006	0.070	0.043	0.047	0.027	0.500	0.626
2	0	1+	0.000	0.005	0.041	0.030	0.284	0.100	0.000	0.005	0.324	0.140
2	1	1+	0.360	0.510	0.061	0.081	0.272	0.145	0.246	0.055	0.965	0.792
2	2+	1+	0.889	1.007	0.028	0.029	0.243	0.133	0.222	0.082	1.382	1.251
3+	0	1+	0.000	0.036	0.400	0.498	0.400	0.417	0.200	0.068	1.000	1.019
3	1	1	0.250	0.485	0.200	0.284	0.250	0.303	0.050	0.102	0.750	1.175
3	1	2+	0.400	0.558	0.075	0.209	0.125	0.260	0.050	0.094	0.650	1.121
3	2+	1	0.769	0.854	0.192	0.189	0.231	0.401	0.154	0.204	1.346	1.649
3	2+	2+	0.671	1.093	0.184	0.184	0.276	0.278	0.263	0.138	1.408	1.693
4+	1	1	0.400	0.520	0.450	0.437	0.400	0.382	0.200	0.153	1.450	1.492
4+	1	2+	0.400	0.633	0.520	0.661	0.520	0.545	0.016	0.127	1.600	1.965
4+	2+	1	0.550	0.900	0.250	0.531	0.750	0.375	0.450	0.207	2.000	2.013
4+	2+	2+	0.953	1.138	0.582	0.612	0.500	0.436	0.400	0.191	2.435	2.377

[1] Persons Per Household
Workers per Household
Autos Per Household

[2] Home Based

[3] Diary
Telephone Interview

TABLE 23
COMPARISON OF TRIP RATES FROM DIARY AND TELEPHONE INTERVIEW SURVEYS
(24 HOURS)

HOUSEHOLD CATEGORY[1]			TRIP PURPOSE									
			HB[2] WORK		HB EDUCATION		HB OTHERS		NHB		TOTAL	
P	W	A	D[3]	T[3]	D	T	D	T	D	T	D	T
1+	0	0	0.000	0.006	0.333	0.108	1.542	0.747	0.313	0.117	2.208	0.978
1+	1+	0	0.906	1.076	0.281	0.217	1.031	0.849	0.563	0.351	2.781	2.493
1	0	1+	0.075	0.017	0.100	0.099	1.900	1.512	1.025	0.397	3.300	2.025
1	1	1+	0.977	1.188	0.031	0.047	1.391	1.170	1.258	0.881	3.680	3.285
2	0	1+	0.000	0.019	0.162	0.081	3.514	2.757	1.054	0.526	4.784	3.383
2	1	1+	1.167	1.285	0.228	0.226	3.079	2.305	1.658	0.913	6.289	4.278
2	2+	1+	2.257	2.455	0.167	0.106	2.757	1.983	1.993	1.109	7.188	5.652
3+	0	1+	0.083	0.166	1.333	1.205	4.250	4.234	1.833	1.073	7.500	6.631
3	1	1	1.400	1.307	0.600	0.501	3.100	3.059	1.850	1.183	7.050	6.140
3	1	2+	1.200	1.418	0.425	0.563	3.700	3.954	1.075	1.324	6.475	7.258
3	2+	1	1.962	2.281	0.423	0.423	2.654	3.054	1.769	1.299	6.885	7.056
3	2+	2+	2.000	2.748	0.592	0.511	3.474	3.286	2.566	1.489	8.737	8.034
4+	1	1	1.400	1.345	1.150	1.054	3.350	4.257	1.350	1.237	7.350	7.892
4+	1	2+	1.160	1.491	1.360	1.573	4.740	6.176	2.230	2.004	9.580	11.244
4+	2+	1	1.950	2.509	0.650	1.202	4.900	3.488	1.500	1.346	9.100	8.545
4+	2+	2+	2.747	3.150	1.465	1.436	5.429	4.535	3.418	1.687	13.076	10.807

[1] Persons Per Household
Workers per Household
Autos Per Household
[2] Home Based
[3] Diary
Telephone Interview

(i) Even though daily per household trip rates overall were higher in the diary survey than in the telephone survey, this phenomenon does not hold true for all categories.

(ii) Reported non-home-based trips are quite consistently higher in the diary results than in the telephone survey results, for both time periods. These results were expected, considering the "method" differences.

(iii) Home-based work and home-based school trips are quite consistently higher in the telephone survey, for both time periods. These results are somewhat surprising and, except for sampling vagaries, difficult to explain. It was expected that these significant and easily-remembered trips would be well reported in the telephone survey, but it was not expected that they would be less well reported in the diary survey.

The overall conclusion from these comparisons is that the diary results should not be used without reservation and qualification as "the standard" in estimating of trip generation. Although higher overall trip rates were reported in the diary survey, specific generation rates derived from the telephone survey should not necessarily be replaced by diary results.

4.4.2 Preliminary Mode Choice Analysis

The diary results were meant to give further insight into the factors affecting mode choice. Auto ownership/auto availability is obviously an important factor, with data from across North America indicating the high proportion of transit riders that are transit captives. One initial application of the diary results was to measure the extent of transit captive ridership in Greater Vancouver.

In the trip diary questionnaire, each respondent was asked whether a car was available to him or her for each trip that was actually made by transit. In almost 80% of the cases, the respondent indicated that no car was available. Further inspection of the data, including cross-tabulations against the household's car ownership and the person's age, sex and whether they hold a driver's license, confirmed that the respondents' answers could generally be used as a reliable measure of transit captivity. (There would inevitably be anomalies. For example, a person who leaves his car at home and takes the bus to work might be expected to answer "NO" regarding the car availability for any subsequent transit trip but would not truly be a transit captive.)

Tables 24, 25 and 26 present results of the diary data depicting weekday mode choice by trip purpose for, respectively, the morning peak period (6:45 - 9:15) the evening peak period (15:30-18:00) and the 24-hour total. (Day 3 data was excluded in preparing these tables.) Results such as these have obvious bearing on the policies and strategies for marketing and funding transit.

These results have also been an impetus for a review of the premises and procedures by which travel demand is modelled and forecast by the GVRD and its member municipalities. Namely, the transportation demand model currently assumes that, in effect, there is an "open choice" of modes for any given trip, the choice being decided on the basis of the relative ease of access by the competing modes that can be taken between the origin and destination. The diary results seem to suggest that a "fixed" or base assignment to transit might be made to reflect transit captives, this assignment being largely insensitive to assumed changes in transit's level of service. Concurrently, better measures of the elasticity of demand might be determined using data from "choice riders" as a means of projecting the likely payoff from changes in the level of service.

TABLE 24
MODE SPLIT RESULTS FROM TRIP DIARY SURVEY
AM PEAK 6:45 to 9:14

MODE	PURPOSE						
	HB[1] WORK	HB SHOP	HB SCHOOL	HB OTHER	NHB	UNKNOWN	TOTAL
Auto Passenger	4.36%	0.42%	8.27%	2.76%	1.71%	0.10%	17.62%
Auto Driver	32.55%	1.50%	4.26%	21.28%	10.36%	0.49%	70.45%
Transit Captive	3.73%	0.17%	3.77%	0.66%	0.63%	0.03%	9.00%
Transit Choice	1.81%	0.07%	0.59%	0.35%	0.10%	0.00%	2.93%
Total	42.46%	2.16%	16.89%	25.05%	12.81%	0.63%	100.0%

[1] Home Based

TABLE 25
MODE SPLIT RESULTS FROM TRIP DIARY SURVEY
PM PEAK 15:30 - 17:59

MODE	PURPOSE						
	HB WORK	HB SHOP	HB SCHOOL	HB OTHER	NHB	UNKNOWN	TOTAL
Auto Passenger	2.50%	2.42%	2.08%	7.64%	4.92%	0.06%	19.61%
Auto Driver	18.21%	8.65%	1.52%	23.01%	20.01%	0.51%	71.90%
Transit Captive	3.34%	0.90%	0.87%	0.90%	1.10%	0.00%	7.11%
Transit Choice	1.04%	0.11%	0.03%	0.14%	0.03%	0.03%	1.38%
Total	25.09%	12.08%	4.50%	31.69%	26.05%	0.59%	100.00%

TABLE 26
MODE SPLIT RESULTS FROM TRIP DIARY SURVEY
ALL DAY

MODE	PURPOSE						
	HB WORK	HB SHOP	HB SCHOOL	HB OTHER	NHB	UNKNOWN	TOTAL
Auto Passenger	2.10%	2.18%	3.15%	7.43%	5.04%	0.12%	20.02%
Auto Driver	15.51%	7.77%	2.56%	24.77%	21.03%	0.62%	72.26%
Transit Captive	1.95%	0.75%	1.52%	1.12%	0.97%	0.04%	6.35%
Transit Choice	0.72%	0.13%	0.20%	0.25%	0.07%	0.01%	1.37%
Total	20.27%	10.83%	7.42%	33.58%	27.11%	0.78%	100.00%

4.4.3 Other Applications of the Diary Data

Further analysis is proceeding using the diary data as a resource. This resource is also available to other interested researchers. While it is not the immediate intention of the GVRD to pursue these research avenues, the diary results might be used to investigate:

(a) annual distance driven by household type and auto ownership

(b) mode choice, trip rates by household structure and hierarchy

(c) mode choice, trip rates, or travel distance by occupation type or family or personal income levels.

Interested researchers are invited to contact the GVRD. As with other components of the Origin-Destination survey, the data is public domain (after deletion of various data items so as to prevent identification of the specific persons or households) and can be made available at a cost reflecting the GVRD's data assembly effort.

5. EXTERNAL CORDON SURVEYS

5.1 Purpose and Components

The telephone interview survey and trip diary survey obtained data on the personal travel by residents of the Greater Vancouver area. To complete the picture of personal travel, it was necessary to measure the travel into, out of and within the area by those who live outside of the area.

The external cordon survey had four components. As described in the following section, the conduct and scope of each of the components were different, as necessitated by the specific circumstances. The four survey components were:

(a) highway cordon surveys, administered at the three points at which major highways penetrate the eastern boundary of the survey area and at the one highway penetrating its northern boundary;

(b) border crossing surveys, administered at the four points along the U.S.-Canada International Boundary that lie within the survey area;

(c) a ferry terminal survey, administered at the two ferry terminals on the western "boundary" of the survey area;

(d) an airport passenger survey. This survey was designed by Transport Canada in collaboration with the GVRD's project team and was administered by Transport Canada at the Vancouver International Airport. Results of the survey had not been made available by Transport Canada in time for inclusion in this report.

5.2 Data Collection and Data Base Preparation

5.2.1 Participants

The task of data collection for the highway cordon, border crossing and ferry terminal surveys was contracted by the GVRD to Terry Partridge and Associates (TPA), a Vancouver-based consulting firm. These surveys also required the cooperation and assistance of, respectively, the B.C. Ministry of Transportation and Highways (MTH), Canada Customs and Immigration, and the B.C. Ferries Corporation.

5.2.1 Highway Cordon Survey

The highway cordon survey at the four points along the survey area's eastern and northern borders made use of a postage-paid survey form. With the help of MTH staff, stations were set up on the outbound lanes of the highways at which vehicles could be flagged over and the driver handed the survey form. The number of vehicles that could be flagged over depended on the traffic conditions, with MTH officials ensuring that flow was not greatly impeded and that hazardous situations were not created. On the northern highway to Squamish, 100% of drivers were given a form; on the Trans-Canada Highway, about 50% of drivers crossing the survey point over the course of the measurement period were given a form. In anticipation of this procedure, the survey forms were numbered sequentially, and logs were kept of the form numbers handed out over each 15-minute interval; concurrent counts of traffic volumes in both directions were kept, which provided the control totals for factoring the returned forms. The surveys were conducted from 08:00 to 18:00, that is, during daylight hours. Just over 10,000 forms were handed out, of which just over 3000 were returned. Although about 500 forms were rejected during editing and coding, the response rate was satisfactory.

Appendix C.3 shows the survey form distributed at the highway cordon stations. The following points can be noted:

(a) The form attempted to capture data on the driver's trip making for the entire day.

(b) The form depicts the "superzone" system used by the GVRD. This format proved to be easily understandable by those completing the forms. Nevertheless, the use of superzones gives rise to the problem of disaggregating the results into the zones of the 350 zone system in the GVRD's transportation model.

(c) The form enabled responses of residents of the survey area to be distinguished from those of non-residents. The results from residents from this survey can be compared with the results from the telephone survey while avoiding the problem of double counting.

(d) The trip purpose categories of the telephone survey were repeated in the highway cordon survey, with the addition of the "Delivery" category.

(e) Respondents were asked to note the trip number on which they were handed the form. By cross-referencing the trip number to the log detailing when each form was handed out, the respondent's travel time specifications could be validated. Alternatively, in cases where respondents did not provide arrival time data, these specifications could be "scaled" in relation to the known time.

5.2.2 Border Crossing Survey

The border crossing survey was administered to outbound (southbound) vehicles at the four international border crossing points on the southern perimeter of the survey area. Outbound vehicles are not obliged to stop and Customs officials were concerned about possible traffic tie-ups. Accordingly, it was necessary to design a simplified and condensed survey format which could be administered to drivers as they drove past the border station.

Appendix C.3 presents the recording form used by the contractor's staff. It can be noted that:

(a) The interviewer would note and record the time of the interview and the vehicle type and occupancy. Concurrent counts of total volumes in both directions were obtained from Customs officials, providing control totals by which to factor the sample responses.

(b) Residents of the survey area could be distinguished from non-residents.

(c) Drivers were asked to describe only the (origin of) the trip they were currently making. Drivers were shown a map of the GVRD's "superzone" system in order to identify the place of origin.

(d) The origin description (i.e. type) was to be used as a surrogate for a trip purpose specification.

The interviews were conducted over a three-day period in October, 1985. At the two busier border crossings (Highway 99 and Point Roberts), one-day counts were taken over the period 07:30 to 18:00, excepting gaps for meals and other rest periods for the interviewers. At the two low-volume crossings (Highways 13 and 15), interviews were administered over three-hour periods at each crossing on the same day.

5.2.3 The Ferry Terminals

Appendix C.3 shows the survey form on which interviewers recorded data. This survey was administered to the drivers of vehicles waiting in the holding area at each of the two ferry terminals. After passing through the fare-payment booths, outbound vehicles are assembled in the holding area to await boarding. This allowed for relatively high sampling rates for outbound vehicles. The B.C. Ferries Corporation provided data on the number of vehicles by type on each inbound and outbound sailing, as control totals for calculating sample expansion factors.

With reference to the survey form, it can be noted that:

(a) Residents of the survey area could be distinguished from non-residents.

(b) The interviewer could note vehicle occupancy and type (omitted from the form), and the ferry's sailing time could be used as a surrogate for the trip time of the vehicle. (Inspection of the reported trip start time indicated that these responses were not reliable; some trips must have involved breaks or "detours" for other purposes, and many longer-distance trips had begun hours earlier.)

(c) Trip origins were located in relation to the "superzones."

(d) Simplified origin and trip purpose categories were used to classify the type of trip.

(e) Description of the "reverse trip" was intended to compensate for not having measured inbound trips. (The "reverse" trip was an earlier inbound trip for off-shore residents and a future inbound trip for mainland residents.) This data has not proven to be sufficiently comprehensive and reliable.

6. SCREENLINE, OCCUPANCY AND CLASSIFICATION SURVEYS

6.1 Purpose and Scope

Counts of actual vehicle and passenger volumes were required, especially at screenline points. The actual counts would provide a basis for adjusting and factoring the survey results and for calibrating the GVRD's transportation model.

The municipalities, B. C. Transit and the provincial MOTH all collect traffic or passenger count data at a variety of stations, and by a variety of methods and procedures. As part of the Origin-Destination Survey project, a task was to compile the various counts relevant to screenline locations and to conduct or contract for additional counts as necessary to supplement the available data.

Figure 8 depicts the screenline locations, at which count data were collected for over 170 stations/directions. These stations and screenlines were chosen to capture all traffic moving into and out of the Region's so-called "super zones" (e.g. the CBD, the North Shore, etc.), and included all of the river crossing points. Also included were the counts at the external entry points - the ferries, airport, border crossings, and highway stations - which served the double purpose of providing control totals for the various surveys described in Section 5.

6.2 Data Analysis

Processing of the assembled data at GVRD included the following procedures:

(a) Merging and harmonizing raw data files arriving in a variety of formats. This included calculating axle adjustment factors to apply to data obtained from "hose counters."

(b) Averaging multi-day counts and applying seasonal adjustment factors for counts undertaken earlier in 1985, to arrive at counts representing a typical weekday for the Fall of 1985.

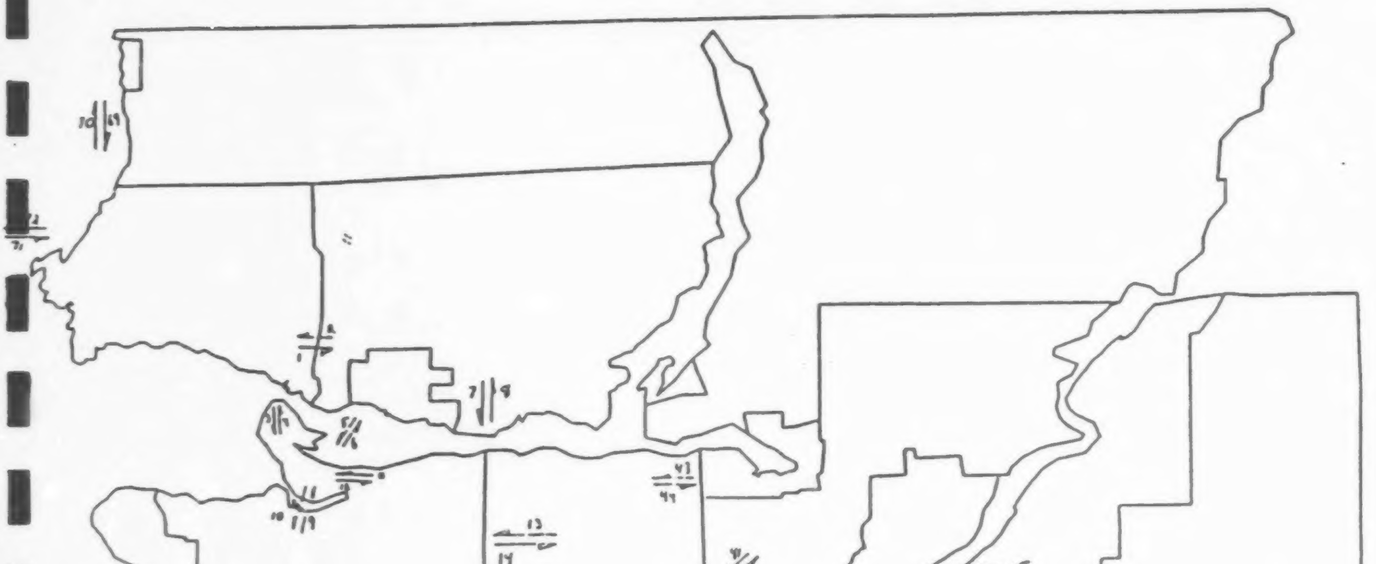
(c) Calculating and applying expansion factors for vehicle occupancy and vehicle classification counts. Most of these counts were conducted by the contractor and were done on a sampling basis rather than on a continuous basis.

(d) Preparing data bases and data base inquiry procedures with related documentation. (See Appendix D for a description of the data bases and file structures.)

6.3 Results

The GVRD report, "Vehicle and Passenger Screenline Survey" describes the data base assembly procedures and provides a guide to data base inquiry.

Figure 8
GVRD Screenlines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It also contains tabulations of hourly count data for each of the approximately 170 stations/directions. Table 27 provides an example of the tabulations in the report; the example is for the Pattullo Bridge (Screenlines 37 and 38 in Figure 8, a four-lane bridge across the Fraser River between Surrey and New Westminster). As outlined in the report, the data base can be addressed by the user to:

(a) total travel by mode for selected station(s) or by screenline number(s) by selected time intervals (15-minute, 30-minute, hourly, multi- hourly, 24-hour) for selected time periods (e.g. 6:00 - 8:44, 15:45 - 16:29, etc.), all with or without station/direction sub-totals;

(b) averages by selected station(s) or screenline(s) by selected intervals (15-minute, hourly, etc.) for selected time periods, with or without station/direction sub-totals.

With the support and assistance of the municipalities, B. C. Transit and MOTH, it is the intention of the GVRD to compile 1987 traffic count data in the same manner as that of 1985. The resulting data bases will allow for "longitudinal" comparisons to identify actual volume changes over the intervening period. In addition, "forecast" 1987 screenline volumes derived from GVRD's transportation model calibrated to 1985 data will be compared with actual 1987 volumes; the results of this comparison may identify appropriate adjustments or refinements to be made to the calibration.

TABLE 27
SAMPLE SCREENLINE REPORT

1985 GVRD Screenline Station: 128E - PATULLO BRIDGE

Time Begin	Direction	Total Vehicle	Auto	Truck	Taxi	Vehicle Passngr	Transit Passngr	Total Person	Auto Occup	Transit M Split
00:00	N-Bnd	346	346	0	0	98	0	444	1.28	
01:00	N-Bnd	148	148	0	0	36	0	184	1.24	
02:00	N-Bnd	110	110	0	0	21	0	131	1.19	
03:00	N-Bnd	81	81	0	0	13	0	94	1.16	
04:00	N-Bnd	170	170	0	0	19	0	189	1.11	
05:00	N-Bnd	881	852	27	2	116	0	997	1.13	
06:00	N-Bnd	3,522	3,386	127	9	485	367	4,374	1.14	8.39%
07:00	N-Bnd	3,795	3,693	95	7	618	366	4,779	1.16	7.66%
08:00	N-Bnd	3,336	3,193	117	26	519	500	4,355	1.16	11.48%
09:00	N-Bnd	2,205	2,060	144	1	491	193	2,889	1.22	6.68%
10:00	N-Bnd	1,905	1,746	142	17	435	158	2,498	1.23	6.33%
11:00	N-Bnd	1,882	1,717	160	5	493	139	2,514	1.26	5.53%
12:00	N-Bnd	1,782	1,637	135	10	523	86	2,391	1.29	3.60%
13:00	N-Bnd	1,849	1,663	175	11	666	99	2,614	1.36	3.79%
14:00	N-Bnd	2,083	1,929	141	13	580	121	2,784	1.28	4.35%
15:00	N-Bnd	2,295	2,177	103	15	806	181	3,282	1.35	5.51%
16:00	N-Bnd	2,097	1,999	84	14	673	142	2,912	1.32	4.88%
17:00	N-Bnd	1,813	1,757	41	15	724	91	2,628	1.40	3.46%
18:00	N-Bnd	1,734	1,697	33	4	844	78	2,656	1.49	2.94%
19:00	N-Bnd	1,429	1,397	15	17	721	42	2,192	1.50	1.92%
20:00	N-Bnd	1,010	974	26	10	532	33	1,575	1.53	2.10%
21:00	N-Bnd	937	909	20	8	435	48	1,420	1.46	3.38%
22:00	N-Bnd	900	866	18	16	430	40	1,370	1.48	2.92%
23:00	N-Bnd	697	685	6	6	248	19	964	1.36	1.97%
		37,007	35,192	1,609	206	10,526	2,703	50,236	1.28	5.38%
00:00	S-Bnd	743	743	0	0	211	0	954	1.28	
01:00	S-Bnd	381	381	0	0	92	0	473	1.24	
02:00	S-Bnd	194	194	0	0	38	0	232	1.20	
03:00	S-Bnd	116	116	0	0	17	0	133	1.15	
04:00	S-Bnd	79	79	0	0	8	0	87	1.10	
05:00	S-Bnd	114	113	0	1	21	0	135	1.18	
06:00	S-Bnd	530	501	25	4	88	41	659	1.17	6.22%
07:00	S-Bnd	1,516	1,458	48	10	250	184	1,950	1.16	9.44%
08:00	S-Bnd	1,733	1,597	126	10	265	191	2,189	1.15	8.73%
09:00	S-Bnd	1,398	1,210	177	11	276	55	1,729	1.20	3.18%
10:00	S-Bnd	1,479	1,349	122	8	406	77	1,962	1.27	3.92%
11:00	S-Bnd	1,625	1,488	129	8	552	131	2,308	1.34	5.68%
12:00	S-Bnd	1,784	1,613	157	14	518	88	2,390	1.29	3.68%
13:00	S-Bnd	2,003	1,819	167	17	714	146	2,863	1.36	5.10%
14:00	S-Bnd	2,430	2,221	200	9	733	211	3,374	1.30	6.25%
15:00	S-Bnd	3,241	3,118	116	7	814	398	4,453	1.25	8.94%
16:00	S-Bnd	3,453	3,357	87	9	883	451	4,787	1.26	9.42%
17:00	S-Bnd	3,498	3,381	102	15	885	476	4,859	1.25	9.80%
18:00	S-Bnd	3,154	3,067	74	13	1,126	165	4,445	1.36	3.71%
19:00	S-Bnd	1,946	1,871	56	19	931	60	2,937	1.48	2.04%
20:00	S-Bnd	1,332	1,280	36	16	575	79	1,986	1.43	3.98%
21:00	S-Bnd	1,290	1,255	25	10	555	114	1,959	1.43	5.82%
22:00	S-Bnd	1,435	1,399	10	26	489	85	2,009	1.34	4.23%
23:00	S-Bnd	1,189	1,181	2	6	359	31	1,579	1.30	1.96%
		36,663	34,791	1,659	213	10,806	2,983	50,452	1.29	5.91%
		73,670	69,983	3,268	419	21,332	5,686	100,688	1.29	5.65%

7. SURVEY OF TRAVEL FOR WORK AND BUSINESS PURPOSES

7.1 Background

The feasibility study had recommended that a survey of truck travel during a 24-hour period be included in the overall travel survey. Several obstacles, however, prevented this recommendation from being implemented. First, consensus was not reached within the advisory committee on the desired scope of the survey. Apart from the difficulty in defining what a truck is, there were differences in views as to whether the project should be a truck survey, a heavy truck survey, a goods movement survey, a hazardous goods movement survey, or a commercial travel survey. As well, there would have been problems in operationalizing any of the options. For example, it is a major problem to identify any region's population of trucks, heavy trucks or commercial vehicles and then to sample from this population(1).

There were conceptual difficulties in imagining how results of a survey from a vehicle-based population would be integrated with the telephone survey's results, i.e. from a person-based population. Table 28 presents data on the Lower Mainland vehicle population from the Insurance Corporation of British Columbia. It would appear that over 75% of the roughly 100,000 commercially-licensed vehicles in the Greater Vancouver area are passenger cars or light trucks. A telephone survey of personal travel and a survey of truck travel might both miss the work or business-related travel in passenger cars or light trucks. Similarly, a vehicle-based survey of travel in commercial vehicles might double count some of the trips in cars and light trucks that were reported in the person-based telephone survey.

Finally, there were the constraints of time, staff resources and funds that have been mentioned previously. In the end, the decision was taken to postpone conducting a full scale truck or commercial travel survey. The possibility was acknowledged that the main telephone survey might be used to achieve a representative picture of commercial and business related travel.

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(1) Seemingly, provincial licensing or insurance records might be used. Apart from problems of making a precise identification of the vehicle type from the license or insurance record, there was an overriding problem of actually obtaining access to the data. Recent BC Government guidelines had raised obstacles to provincially-maintained records' being made available to outside agencies or for purposes other than those for which the data was collected. Subsequent communications with the Superintendent of Motor Vehicles have suggested that these impediments might be overcome, but this did not appear to be the case at the time.

TABLE 28
LOWER MAINLAND VEHICLE POPULATION

CLASS[1]	DESCRIPTION	1984	1986
001	Pleasure Use	276,338	276,462
002	Pleasure Use	271,618	194,267
005	Pleasure Use	51,801	59,038
022-6, 122-6	Motorcycles, etc.	18,464	16,952
501-9	Motor Homes	11,846	11,961
Total, Private		630,067	658,680
007	Business & Pleasure	58,845	63,007
012	Artisan	17,775	20,971
013	Delivery	3,207	5,113
016, 018, 088-9	Rentals	4,316	6,139
064, 091-5,) 191-5) 291-5, 364-495)	Various Buses	2,083	2,317
215, 217, 315	Taxis	857	931
141-5, 241-5	Municipal	719	750
Various[2]	Various	17,200	18,870
Total, Commercial	All Types	103,002	118,098

[1] Data provided by Insurance Corporation of British Columbia for Lower Mainland Licensing Area which includes Vancouver CMA, Mission and Matsqui.

[2] Includes all remaining classes but not trailers. Trucks make up the majority of vehicles in these classes.

It was recognized that the telephone survey was not the device for directly obtaining data on work-related travel. For example, a person travelling extensively for work or business purposes would likely be unwilling or unable to recall each trip. Consider also the impracticality of a spouse's trying to list the at-work itinerary of his or her mate.

Nevertheless, Since the telephone survey would achieve a representative sample of the region's households, the advisory committee considered that the same sample might also yield a representative subset of the people driving trucks and/or other commercial vehicles. These people might then be re-surveyed separately using a travel diary. The results of this follow-up survey might then be factored to represent the corresponding work-related travel of the population. That being the case, a representative sampling of travel by all persons, by all modes (including trucks) for all purposes at all times of the day would be obtained, thus satisfying the overall objective of the project.

7.2 Sample Identification

On this basis, the following question was inserted into the telephone survey's script and procedure: "Are any people in your household employed in the delivery of goods, messages or people?" The interviewers were asked to make an entry into the appropriate box on the survey form, to inform the household about the intended follow-up survey, and to explain that the telephone survey was for personal travel only. When survey forms were returned to the GVRD after keypunching, "flagged" forms were pulled and placed in a separate file.

Within the first week of the telephone survey, it had become apparent that the above question was not fully adequate. In particular, people such as plumbers, TV repairman, real estate agents, etc. were answering "NO" to the question about delivery, but were indicating in some cases that they travel during their working day. Accordingly, new instructions were issued to the interviewers to flag households responding affirmatively to the question or showing other work-related travel if data on that travel was not being provided over the phone.

In order that the follow-up survey of flagged households could be carried out during the same period as the rest of the travel survey, a cut-off date (November 15) was imposed. At the cut-off date, 20,369 households of the CMA's estimated 522,000 households had completed telephone interviews (a 3.9% sample). After inspecting the flagged records and removing bus drivers, taxi drivers and other inappropriate flags where they could be found, a total of 820 households were put into the group for the follow-up survey. (Bus movements would be derived from BC Transit data; taxi travel was to be measured in a separate project.)

As the cut-off date neared, the decision had to be made about whether or not to proceed with the follow-up survey. Two cautionary notes advised against proceeding. First, it was not possible to know, either in an overall sense or by occupational sub-grouping, whether the flagged sample was representative of the population. The occupational codes of Statistics Canada, for example, provide a precise estimate of any area's population of delivery persons, but do not distinguish between the plumbers, salesmen, etc. who are "itinerant" and those that are "stationary". Secondly, with such a small initial sample, it was recognized that a high response rate would be necessary if the follow-up survey's results were to be meaningful.

7.3 Questionnaire

The advisory group's expectation was that a high response rate would likely be achieved. For one thing, we were dealing with people who had previously shown themselves to be cooperative, namely by participating in the telephone survey. Also, a rather novel and attractive reward - two "Scratch and Win" lottery tickets - was offered to those who completed and returned their survey forms. Considering also the relatively low cost of printing and distributing the packages for the follow-up survey, the group decided to proceed with the data collection phase.

Appendix C.4 shows the form used in the Survey of Travel for Work and Business Purposes, being a one-day travel diary. As well as this form, each mail-out package included a letter to the household referring to the telephone survey and explaining the purpose of the follow-up survey. A second letter that the householder might, if necessary, show to his or her employer was also included. The householder was instructed to complete the one-day diary for a "typical" workday.

7.4 Results

Eight of the 820 packages that were mailed out were returned unopened. Eventually, 145 forms were returned, for a response rate of 18%. Twenty-five forms were rejected upon inspection (no usable data; household should not have been flagged in the first place, etc.). Thus, while the response rate was within the range typical of surveys of this type, the number of returned forms was too low to yield results that are useful for trip generation or distribution analysis, even at a disaggregate level. A more complete survey will be necessary to derive a usable measure of truck or commercial travel patterns and trip rates. In 1987, staff of the GVRD and the municipalities will undertake to determine the desired scope of a survey - i.e. whether it is of trucks, heavy trucks, commercial travel, etc. - and to design a method of conducting the survey. This being accomplished, data collection and analysis could proceed in 1988.

Nevertheless, the results from the 120 responses can be used to provide some broad insights into commercial travel. Table 29, for example, provides an indication of the number of trips that are made by commercial vehicles during the course of a day. The relatively lower trip rates of heavy trucks compared to passenger cars and light trucks reinforces some basic expectations. Table 30 presents the time profile of commercial trip making, again reinforcing the expectation that commercial travel "drops off" during peak hours when other roadway users either discourage commercial trip making or reduce the number of trips that can be made during the hour. Table 31 presents some statistics on the distances driven by commercial vehicles, stratified by vehicle type and use.

TABLE 29
TRIP FREQUENCY BY COMMERCIAL VEHICLE TYPE

NUMBER OF TRIPS	PASS CAR	LIGHT TRUCK	HEAVY 2-AXLE	HEAVY 3-AXLE	OVERALL
1-5	8	12	6	8	34
6-10	14	9	4	13	40
11-15	9	8	3	3	23
16-20	1	6	3	1	11
21-25	1	1	1	0	3
25-30	0	5	0	0	5
31+	1	4	0	0	4

TABLE 30
TIME START PROFILE OF COMMERCIAL TRAVEL

HOUR BEGINNING	PASS CAR	LIGHT TRUCK	HEAVY 2-AXLE	HEAVY 3+AXLE	OVERALL
0 AM	2	1	0	0	3
1	1	0	0	0	1
2	1	0	0	0	1
3	2	1	0	1	4
4	3	0	1	1	5
5	3	4	0	0	7
6	2	7	0	6	15
7	9	11	5	15	40
8	24	41	12	15	92
9	30	70	21	18	139
10	37	69	32	19	157
11	40	79	25	22	166
12 PM	41	65	28	15	149
13	27	69	25	13	134
14	40	73	21	23	157
15	34	56	7	18	115
16	24	38	7	10	79
17	5	13	3	2	23
18	2	10	4	0	16
19	4	2	3	0	9
20	2	1	1	1	5
21	3	0	2	0	5
22	2	0	0	0	2
23	0	0	1	0	1

TABLE 31
STATISTICS ON VEHICLE USE BY CLASS AND FUNCTION

CLASS AND FUNCTION	AVG. DISTANCE DRIVEN PER DAY (kilometres)	STD. DEV'N. OF DISTANCE	NUMBER OF OBSERVATIONS
AUTOMOBILE			
Courier	122.4	95.2	8
Repair/Service	58.3	46.3	3
Sales Calls	101.2	59.2	15
Light Delivery	30.5	12.5	2
Other	190.0	98.0	2
Overall	103.8	67.6	30
LIGHT DUTY TRUCK			
Courier	78.3	46.3	4
Repair/Service	83.0	30.1	5
Sales Calls	103.0	35.4	3
Light Delivery	119.0	62.2	22
Other	102.3	50.1	4
Overall	107.3	55.8	38
HEAVY TRUCK, 2 AXLES			
Light Delivery	118.8	31.8	4
Heavy Delivery	108.6	49.2	11
Overall	111.3	45.5	15
HEAVY TRUCK, 3+AXLES			
Light Delivery	132.2	51.4	12
Heavy Delivery	151.3	42.8	4
Other	79.3	56.0	3
Overall	127.9	52.8	19

8. TAXI SURVEY

8.1 Background

In 1985, approximately 890 taxis belonging to 16 separate fleets were operating within the Greater Vancouver area. The feasibility study had recommended that a 25% sample of the taxi fleet should be surveyed and that use could be made of the daily trip sheets that drivers are obliged complete. The working group investigated how this recommendation might be implemented, identifying several obstacles in the process.

In British Columbia, the Motor Carrier Commission, a provincial agency, regulates commercial vehicles which cross municipal boundaries. This includes taxis and transit buses, as well as delivery vehicles. The MCC requires that taxi trip sheets be completed and, on demand, be made available to the MCC. No standard taxi trip sheet form is used but certain information should be present. This, however, does not include the number of passengers carried on the trip. Also, it is the responsibility of the vehicle owner to complete and compile the trip sheets. Several Greater Vancouver fleets are made up of individual owner-operators such that there may be no control by the fleet to ensure the completeness and accuracy of trip sheets. Furthermore, until December 1985, it was illegal for taxis to pick up fares outside of the municipality in which they were licensed to operate except under pre-arranged contract. While indications are that significant number of "illegal" pickups were and are being made, most such pickups would not have been reported on the trip sheets. Note too that, for tax reasons, it is in the self-interest of all drivers not to report trips and the associated revenues.

In summary, the working group's investigations showed that despite the apparent usefulness of trip sheets as a data source, there is no certainty that a complete (or representative) file can be assembled for any given day, nor that the information contained on the trip sheets will be complete and accurate.

8.2 Data Collection

To attempt to overcome these problems, each of the managers of the 16 fleets was contacted by a member of the GVRD staff and by a member of staff from the "home" municipality. The overall purpose of the travel survey was outlined, as well as the benefits that could potentially accrue to taxi operators from the information that would be collected. Each manager was asked to participate in the survey. In particular, each manager was asked to distribute a letter of explanation to each driver, and on the designated Survey Day (Wednesday, November 20), to note the number of taxis operating on each shift and to attempt to obtain (a photocopy of) the trip sheets for each taxi for each shift. Some managers from fleets that did not normally record all desired information items - e.g., the number of passengers - were asked to remind their drivers to record this data.

8.3 Response

Based on the initial contacts, the advisory committee learned that two fleets refused outright to participate in the survey. Since these fleets were both from the North Shore - i.e. a distinct and separate geographic sector - the committee decided to proceed with the taxi survey[1] irregardless. Subsequently, however, based on the returned data, it became evident that data from two other fleets was so incomplete as to be useless. As both these fleets were from key geographic areas, the missing data created unresolvable data gaps. In addition, operating rules and regulations were changed in December 1985, a few weeks after the Survey Day. Taxis were allowed to respond to calls outside their "home" municipality/zone. Thus, while trip tables derived from taxi trip sheets might be used (with reservations) to calibrate for 1985 conditions, these 1985 conditions would not apply to any post-1985 forecast period. Accordingly, apart from summary statistics (average trips per day, average passenger loads per trip), no attempt has yet been made to use the data collected in the taxi survey to produce trip tables.

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[1] The option of having the MCC "call in" the trip sheets for the designated day was rejected. First, there would still be no guarantee that a complete file of complete and accurate trip sheets would be obtained. Second, to encourage their participation and accuracy, drivers and managers were assured by the survey team that there would be no affiliation between the survey and their provincial or federal regulatory masters (i.e. the MCC and Revenue Canada). To have then invoked this affiliation would be to have reneged on this commitment.

9. SKYTRAIN RIDER SURVEY

9.1 Survey Objectives

The commencement of service on the SkyTrain system in January 1986 introduced substantial changes to the transit system in the Vancouver Region. In order to determine the impact of SkyTrain, a survey of SkyTrain riders was undertaken during the week of March 23-27, 1987. The objectives of the SkyTrain Rider Survey were:

(a) to identify the travel patterns of SkyTrain riders in terms of origins, destinations, access mode, walking distance and usage frequency. This information is primarily useful in the planning of future SkyTrain extensions and planning for the integration of bus/SkyTrain services.

(b) to determine the impact of SkyTrain on travel behaviour. Respondents were surveyed concerning their mode prior to SkyTrain, car availability, impact on residential location and shopping habits.

(c) to solicit public attitudes towards SkyTrain generally and also specifically in the areas of reliability, speed, noise, safety, transferring, ticket vending machine use, etc. Information on rider attitudes is useful from a marketing perspective.

9.2 Survey Design

9.2.1 Questionnaire Design

As the information required from the survey was too extensive to be accommodated on a single survey form, two questionnaires designated "A" and "B" were used. As shown in Appendix C.5, each questionnaire contained 16 core questions with Questionnaire A containing additional travel and impact related questions and Questionnaire B containing additional attitudinal questions.

9.2.2 Collection and Distribution

The questionnaires were distributed at stations to all inbound (westbound) riders from the start of service to the end of service. Rapid transit attendants distributing the questionnaires surveyed an average of three stations per day thereby completing all SkyTrain stations in five days from March 23-27, 1987.

Respondents had the option of returning questionnaires to rapid transit attendants (RTA's) or postage paid mailback.

9.2.3 Survey Response

SkyTrain riders responded well to the survey. A total of 4,015 questionnaires were returned of the 12,535 distributed. The response rate of approximately 32% is high for surveys of this kind indicating a strong interest in the SkyTrain system.

9.3 Results

9.3.1 Overview

This section of the report summarizes the major findings of the study focusing on the following areas:

(a) Rider Characteristics - age, sex, car availability.

(b) Travel Characteristics - access mode to and from SkyTrain, walking distance, trip purpose, trip frequency, parking.

(c) SkyTrain Impacts - previous mode, travel time, residential location, shopping habits.

(d) Attitudes to SkyTrain - regarding reliability, vehicle crowding, speed, noise, safety, staff, transferring, ticket machines, etc.

9.3.2 Rider Characteristics

9.3.2.1 Overview

The results from the SkyTrain Rider Survey and the Metropolitan Vancouver Origin-Destination provide profiles of SkyTrain riders compared with that of transit riders in general on the Vancouver Regional Transit System.

9.3.2.2 Sex and Age Profile

A breakdown by sex for both SkyTrain riders and general transit riders is shown in Table 32.

TABLE 32
SEX PROFILE

SEX	SKYTRAIN RIDERS	ALL TRANSIT RIDERS
Male	37.2%	40.7%
Female	62.8%	59.3%
TOTAL	100.0%	100.0%

The comparison shows that SkyTrain riders closely correspond to the sex profile of all transit riders.

A comparison between the age profiles of SkyTrain riders and all transit riders is shown in Table 33. The results show that SkyTrain riders are more heavily concentrated in the middle age groups, age 21-50 years. Representation from the younger age groups (15 or less, 16-20) and the elderly (over 60) is lower for SkyTrain than for transit riders as a whole.

The average age for male SkyTrain riders is 36.5 years and for females is 33.7 years. The overall average age is 34.5 years.

TABLE 33
AGE PROFILE

Age Group (Years)	SkyTrain Riders	All Transit Riders
15 or less	4.4%	9.8%
16 - 20	12.0%	18.7%
21 - 30	33.7%	26.0%
31 - 40	21.4%	13.5%
41 - 50	11.6%	8.6%
51 - 60	8.6%	7.2%
Over 60	8.3%	16.2%
TOTAL	100.0%	100.0%

9.3.2.3 Car Availability

The majority of SkyTrain riders (56.8%) did not have a car available for the trip. This proportion of "captive" riders is considerably lower than the 79.5% for transit riders as a whole indicated by the 1985 Metropolitan Vancouver Travel Survey. It can therefore be concluded that a higher proportion of SkyTrain riders use the system by choice rather than by necessity.

9.3.3 Travel Characteristics

9.3.3.1 Access Mode

Riders were asked how they travelled to a SkyTrain station and from a station to their destination. As shown in Figure 9 the most common modes to the SkyTrain station were bus (43.2%) and walk (39.7%).

A total of 16.6% of riders access the system by car through either driving and parking (7.7%) or by getting dropped off (8.9%).

At the destination end, SkyTrain riders predominantly walk to their final destination (69.4% compared to 26.6% by bus and 2.9% by SeaBus).

9.3.3.2 Walking Distance

The walking distance to transit stations or bus stops is indicative of the size of the catchment area for a transit system. Studies elsewhere have shown that riders will walk further to rapid transit than a bus route reflecting the higher level of service offered by a premium mode. These studies have generally shown that the walking distance for 95% of all trips by bus is within 4 blocks from a bus stop whereas the walking distance for 95% of all rapid transit trips is within 8 blocks.

The SkyTrain Rider Survey asked all riders how far they walked to the station. Table 34 compares the results for all passengers and provides a breakdown by those whose access mode is "walk" and "drove car and parked".

Figure 9
Access Mode to SkyTrain

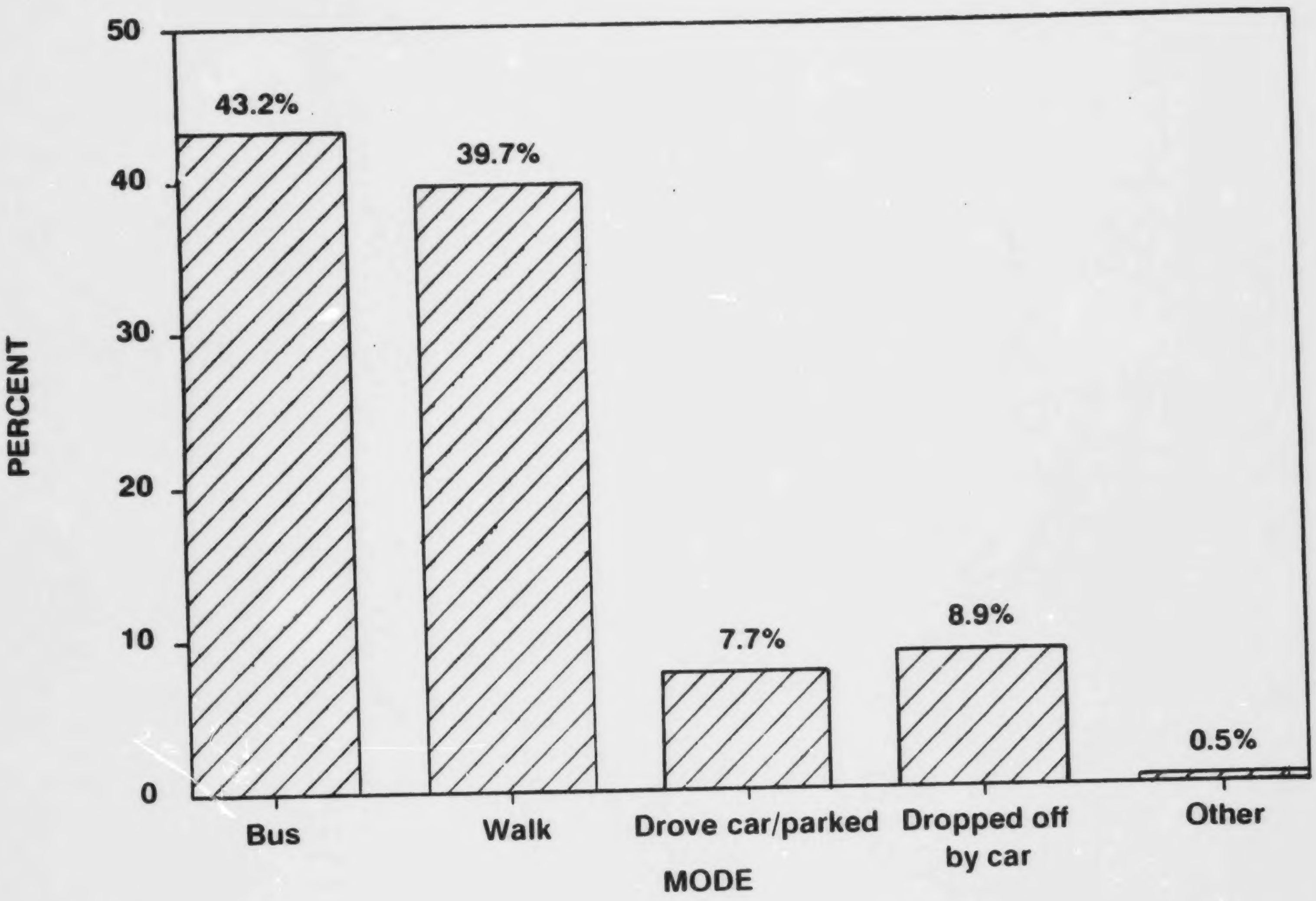


TABLE 34
WALKING DISTANCE TO SKYTRAIN STATIONS

NUMBER OF BLOCKS	CUMULATIVE PERCENT		
	ALL RIDERS	RIDERS WHO WALK	RIDERS WHO DROVE CAR & PARKED
Up to 2 blocks	76.4%	45.1%	95.4%
Up to 4 blocks	89.1%	76.2%	96.4%
Up to 6 blocks	95.6%	90.8%	99.0%
Up to 8 blocks	97.6%	95.4%	99.3%
Up to 10 blocks	99.0%	97.9%	99.6%
10 or more	100.0%	100.0%	100.0%
TOTAL	**100.0%**	**100.0%**	**100.0%**

The results show that riders who walk to the SkyTrain station walk further than those who drive to the station.

9.3.3.3 Trip Purpose

SkyTrain riders were asked the main purpose for their trip. Table 35 compares the trip purposes for SkyTrain riders with those of transit riders as a whole in the Vancouver Region.

TABLE 35
COMPARISON OF TRIP PURPOSES

TRIP PURPOSE	SKYTRAIN RIDERS	ALL TRANSIT RIDERS[1]
Work	63.8%	40.9%
School	8.7%	27.8%
Shopping	7.7%	12.5%
Personal Business	8.4%	6.8%
Social Recreational	6.9%	8.0%
Other	4.5%	4.0%
TOTAL	**100.0%**	**100.0%**

[1] Based on results from the Metropolitan Vancouver Travel Survey.

The results show that 63.8% of SkyTrain trips are work-related as compared to 40.9% for the transit system as a whole. School trips and shopping trips, however, are less significant trip purposes for SkyTrain than for the transit system as a whole. School trips comprise 27.8% of all trips on the transit system but only 8.7% on SkyTrain. Similarly shopping trips comprise 12.5% of transit trips and only 7.7% on SkyTrain. The lower proportion of shopping and school trips by SkyTrain would appear to reflect the nature of SkyTrain as serving regional transit trips rather than these more localized trip purposes.

9.3.3.4 Trip Frequency

SkyTrain riders were asked to identify how many one-way SkyTrain trips they made last week and which days they used SkyTrain. As shown in Figure 10 the extensive use of SkyTrain for work trips is also reflected in the result that the highest frequency of weekly trips on the system is 9-10 trips.

A profile of weekly ridership on the SkyTrain system was derived by asking respondents which days they used SkyTrain the previous week. The results in Figure 11 show an even rate of SkyTrain weekday usage with daily use varying from 17.5-17.9% of total weekly ridership.

SkyTrain usage declines substantially to 6.5% and 4.8% of total weekly usage on Saturday and Sunday respectively.

9.3.3.5 Parking Behaviour

As previously noted, 7.7% of SkyTrain riders can be classified as park-ride users. To obtain further information on park-ride behaviour, those respondents completing Questionnaire A and identifying themselves as driving to a SkyTrain station were asked where they parked. As shown in Figure 12 the majority (65.1%) park on local streets while 22.4% park in a free lot and 12.5% in a pay lot. A total of 95.4% of parking locations are within 2 blocks of a SkyTrain station.

Those who drove a car and parked at a SkyTrain station, ie. park-ride, and those who were dropped off by car were also asked their reasons for not using connecting bus service. As shown in Table 36, the most often noted factors were that the bus service was too infrequent (30.6%) or that buses were too slow (23.3%).

Figure 10
SkyTrain Trip Frequency

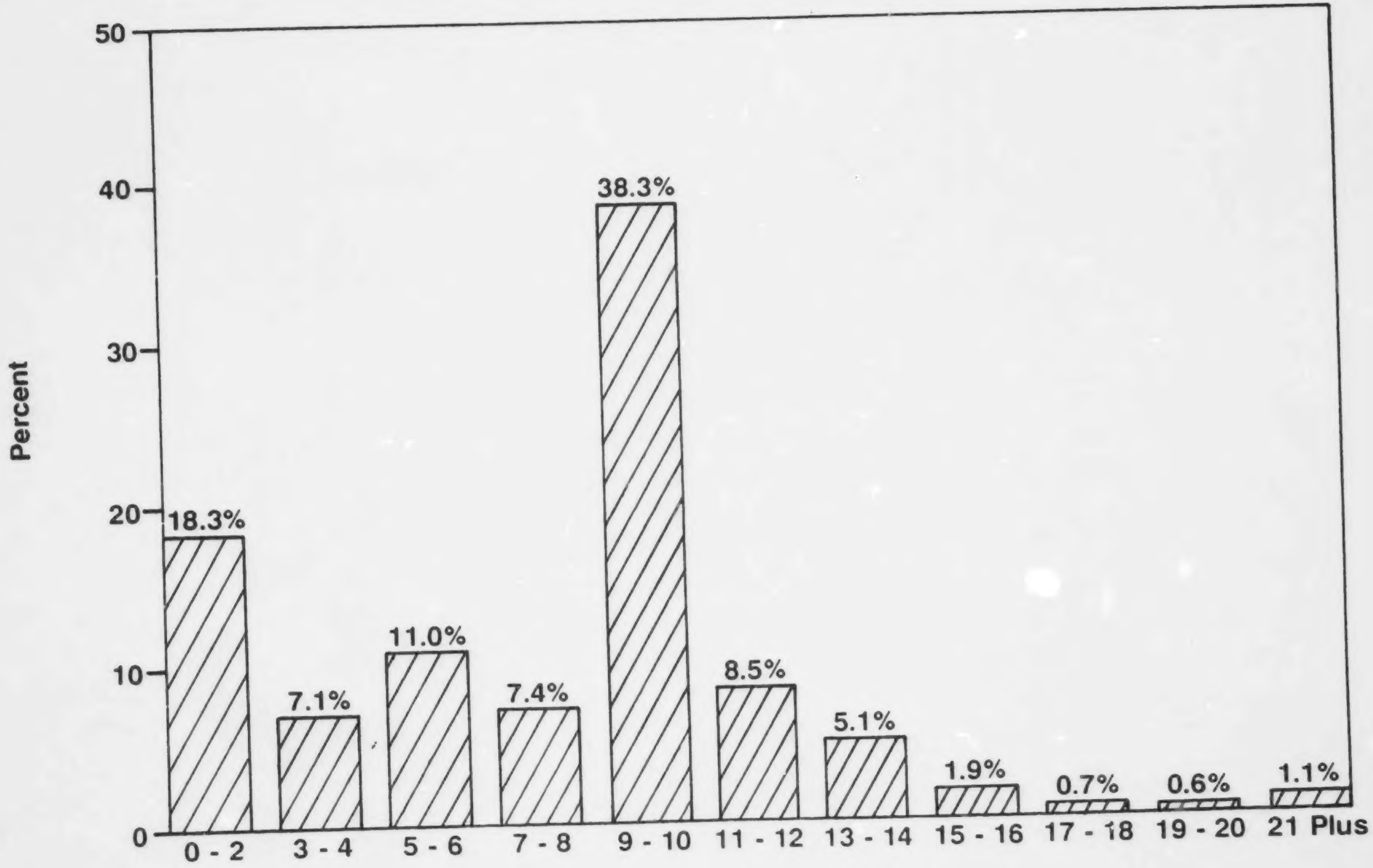


Figure 11
SkyTrain Use by Day of the Week

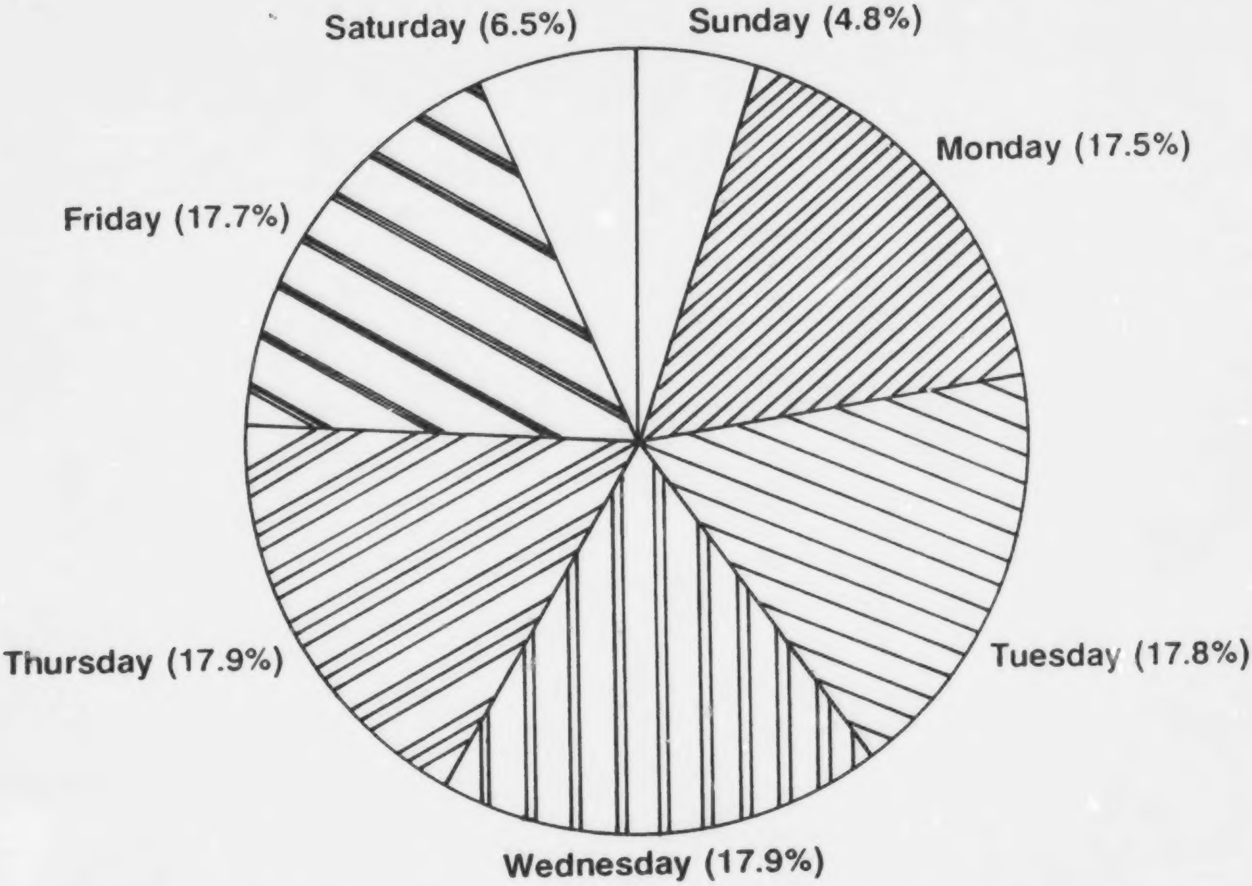


Figure 12
Parking Location

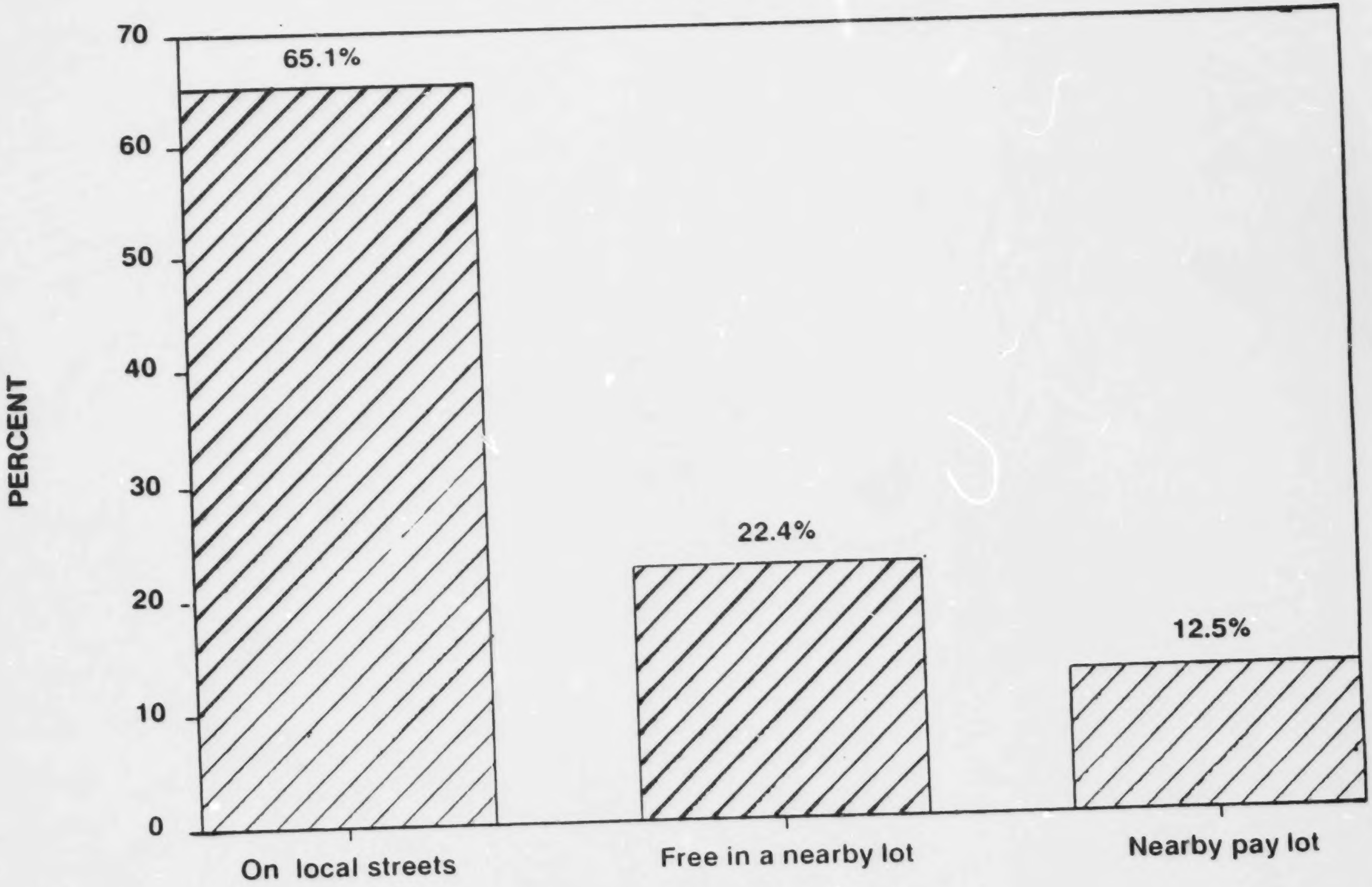


TABLE 36
REASONS FOR NOT USING CONNECTING BUS SERVICE

REASON	PERCENT
1. Don't know about it.	1.9%
2. Bus route not close enough to home/work.	13.4%
3. Bus service too infrequent.	30.6%
4. Transfers are inconvenient.	10.3%
5. Bus is too slow.	23.3%
6. Bus is unreliable.	10.1%
7. Other.	10.4%
TOTAL	100.0%

9.3.4 SkyTrain Impacts

9.3.4.1 Previous Mode of Travel

To determine the previous mode of SkyTrain riders,Questionnaire A asked respondents how they made the equivalent trip prior to SkyTrain.

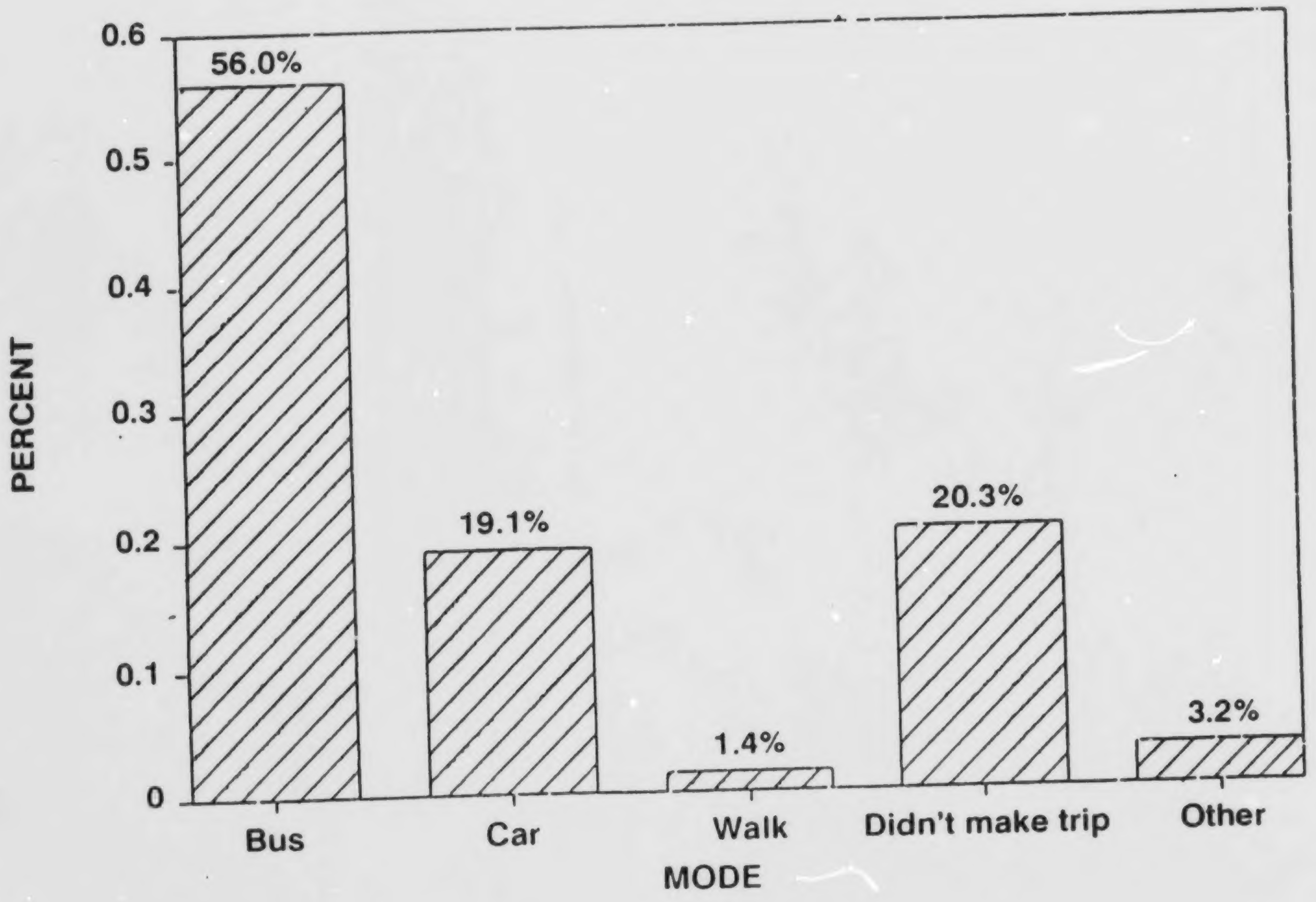
As shown in Figure 13, the largest proportion (56%) formerly used transit. The percentage of SkyTrain riders who appear to have been diverted from the private automobile (19.1%) is very significant and probably indicative of the high level of service offered by SkyTrain. A further 20.3% of SkyTrain riders responded that they didn't make the equivalent trip prior to SkyTrain. This result could be due to two factors: that new riders are attracted to the transit system by the presence of SkyTrain, or that origins and destinations have changed since the introduction of the system.

These two figures do suggest a very significant growth in ridership in the corridor - possibly as high as 70-80 percent.

9.3.4.2 Travel Time

SkyTrain riders were asked whether their travel time has increased or decreased or remained the same compared with their means of travel before SkyTrain. The results in Table 37 show that for 16.5% of all SkyTrain riders, travel time had increased, for 62.8% travel time had decreased and for 20.7% travel time had remained the same as before.

Figure 13
Previous Access Mode



A breakdown by previous mode showed that for those riders who previously made the trip by bus, only 15.2% showed an increase in travel time while 83.7% showed a decrease in travel time as a result of SkyTrain. For previous auto drivers, 43.9% perceived an increase in travel time and 56.1% perceived a decrease in travel time.

The results clearly indicate that SkyTrain travel times are perceived as being competitive with the automobile and are considerably better overall than previous travel times by transit.

TABLE 37
TRAVEL TIME RELATIVE TO PREVIOUS MODE

TRAVEL TIME	ALL SKYTRAIN RIDERS	PREVIOUS BUS RIDERS	PREVIOUS AUTO DRIVERS
Increase	16.5%	15.2%	43.9%
Decrease	62.8%	83.7%	56.1%
Same as Before	20.7%	1.1%	0.0%
TOTAL	100.0%	100.0%	100.0%

9.3.4.3 Accessibility Impacts

The impact of SkyTrain on development will be determined largely by the degree to which home buyers, renters or shoppers perceive the accessibility advantages of the system.

Since the start of SkyTrain service, 26.1% of riders had moved their residence. Of those respondents, 49.3% responded that accessibility to SkyTrain was a factor in choosing the location of their place of residence. Similarily, 27.7% responded that they had changed their shopping habits due to SkyTrain. Table 38 provides a frequency distribution for responses to the question addressing how shopping habits had changed.

TABLE 38
CHANGES IN SHOPPING HABITS

RESPONSE TO QUESTION "HOW HAVE YOUR SHOPPING HABITS CHANGED DUE TO SKYTRAIN?"	PERCENT OF TOTAL WHOSE SHOPPING HABITS HAD CHANGED
1. Shop downtown more often	40.0%
2. Shop at Metrotown more often	17.6%
3. Shop at New Westminster more often	7.5%
4. More convenient to shop	4.7%
5. Go shopping more often	4.5%
6. Take SkyTrain to shop instead of other modes	4.5%
7. Shop along SkyTrain route instead of elsewhere	4.3%
8. Other responses	16.9%
All responses	100.0%

The results appear to indiciate that SkyTrain has enhanced the attractiveness of shopping areas along the line relative to other areas.

9.3.5 Rider Attitudes

9.3.5.1 Overview

Determining public attitudes to various aspects of SkyTrain is useful for future planning and marketing of the system. Attitudes were surveyed on Questionnaire B by asking riders to indicate their level of agreement or disagreement with a variety of statements concerning SkyTrain. The following sections outline the results.

9.3.5.2 General Attitudes

To determine the general attitude of SkyTrain riders to the system, riders were asked to respond to two statements: "SkyTrain service meets my transportation needs" and "SkyTrain is an asset to the community". The results provided in Appendix E.1 show a very positive attitude to SkyTrain and a satisfaction in its capabilities as a transportation system. A total of 81.1% agreed or strongly agreed that SkyTrain was an asset to the community and 75.9% agreed or strongly agreed that SkyTrain met their transportation needs.

9.3.5.3 Reliability and Speed

SkyTrain riders were asked to indicate their attitude to the following statement "SkyTrain service is reliable." As shown in Appendix E.1, 88.4% agreed or strongly agreed with this statement indicating a positive response to the high frequency of service and low incidence of delays on SkyTrain.

Riders also appreciate the fast travel times available by SkyTrain. A total of 89.2% agreed or strongly agreed with the statement: "SkyTrain is a fast mode of travel."

9.3.5.4 Noise and Crowding

SkyTrain riders were somewhat negative concerning noise levels and vehicle crowding on the system. As shown in Appendix E.1, 36.1% disagreed or strongly disagreed with the statement: "SkyTrain is quiet" and 32.8% disagreed or strongly disagreed that SkyTrain cars were not crowded.

9.3.5.5 Safety and Staff Helpfulness

Appendix E.1 shows that SkyTrain riders are generally positive regarding the safety of SkyTrain. A total of 66.9% agreed or strongly agreed with the statement "I feel safe onboard SkyTrain" while 24.9% were neutral and only 8.2% disagreed or strongly disagreed. SkyTrain riders do not appear to substantiate earlier concerns about driverless trains.

10. SKYTRAIN PARKING INVENTORY

10.1 Objectives

The SkyTrain Parking Inventory was undertaken to provide baseline information on parking availability, utilization and tenure within SkyTrain station areas. Parking characteristics within station areas were surveyed prior to the start of service on SkyTrain. Followup surveys conducted after SkyTrain is in service for some time will determine the extent of park-ride demand.

10.2 Method

Field surveys were conducted on weekdays only from November 25th to December 11, 1985, within a 1 kilometre radius of 10 SkyTrain stations located outside the downtown core as shown in Figure 14.

Detailed land use maps were used to record the location of every parking space and parked vehicle. Associated information such as time of day, land use, parking type (on-street, off-street "structure", off-street lot), duration and parking charges (if applicable) was also noted. Information for security parking lots was obtained by telephone.

10.3 Analysis

The field analysis provided data to develop a parking profile for each station area. The report provides baseline data on parking utilization for comparison with post-SkyTrain parking surveys to be undertaken at a later date. Parking Profiles for each station area surveyed are provided in Appendix E.2.

10.4 Results

10.4.1 Pre-SkyTrain Parking Availability

The results of the pre-SkyTrain field surveys established the baseline level of parking demand for later comparison with the two post SkyTrain surveys. The baseline results are shown for nine stations in Appendix E-2 are summarized in Table 39.

Figure 14
SkyTrain Parking Survey

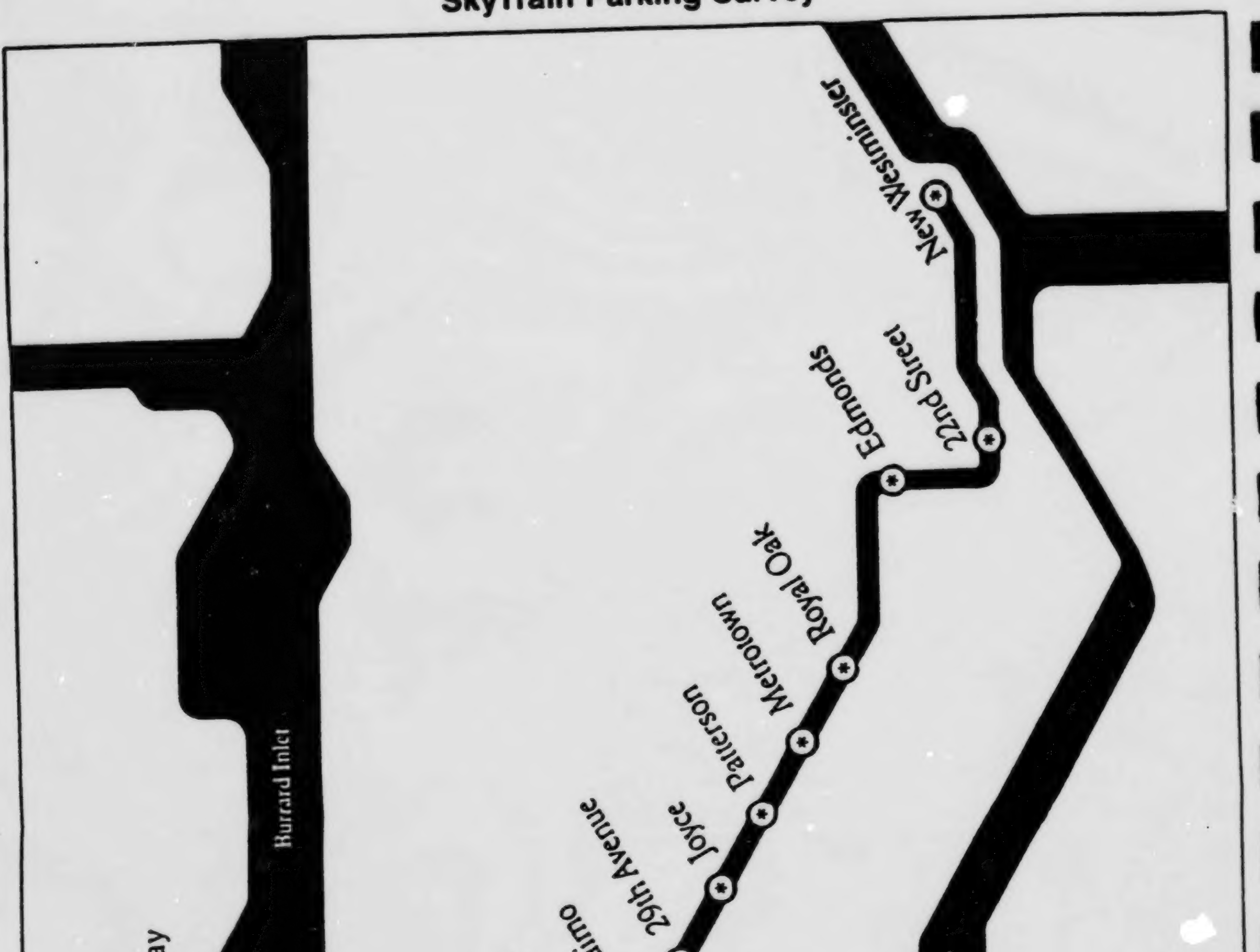

Lonsdale Quay
Sea Bus
Burrard Inlet
Waterfront
Burrard
Granville
Stadium
Main Street
Broadway
Nanaimo
29th Avenue
Joyce
Patterson
Metrotown
Royal Oak
Edmonds
22nd Street
New Westminster
Fraser River
* Station Areas Surveyed

Table 39
Pre-SkyTrain Parking Survey
Parking Availability Summary

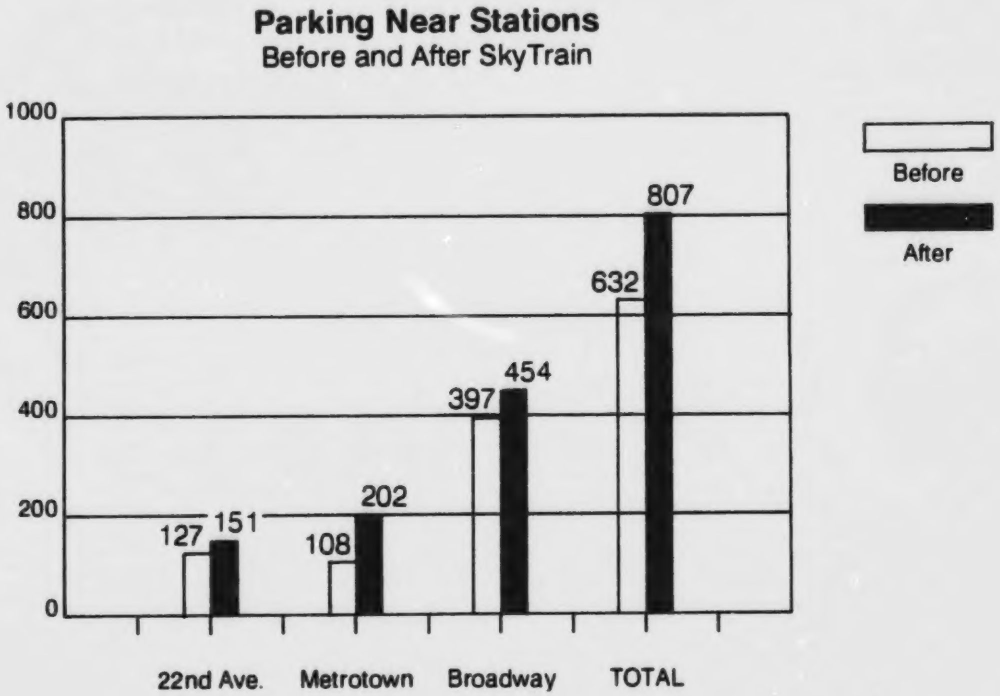
Station	Total Avail-able	Parking Type		Parking Charges		
		On Street	Off Street	Free	Meter	Ticket
New West.	6,444	36.6%	63.4%	64.4%	7.2%	28.4%
22nd Street	3,568	82.3%	17.7%	100.0%	0.0%	0.0%
Royal Oak	6,379	76.0%	24.0%	100.0%	0.0%	0.0%
Metrotown	6,309	33.3%	66.7%	96.2%	0.0%	3.8%
Patterson	3,377	55.0%	45.0%	88.9%	9.9%	1.2%
Joyce	5,781	67.1%	32.9%	100.0%	0.0%	0.0%
29th Avenue	4,466	69.1%	30.9%	100.0%	0.0%	0.0%
Nanaimo	4,943	63.4%	36.6%	100.0%	0.0%	0.0%
Broadway	5,636	54.1%	45.9%	93.9%	1.9%	4.2%
Total	**46,903**	**58.1%**	**41.9%**	**93.0%**	**2.0%**	**5.0%**

These results show that within a 700m radius of SkyTrain stations there are approximately 46,900 available parking spaces. The majority (58.1%) are on-street parking spaces rather than off-street in a residential carport or parking lot and 93% are free of charge rather than meter or ticket parking. Only four of the nine stations have pay parking notably New Westminster station which is located in the downtown area of New Westminster.

10.4.2 Post SkyTrain Parking Utilization

Parking utilization i.e. the number of vehicles actually parked in SkyTrain station areas was surveyed for the pre-SkyTrain and post-SkyTrain periods. The differences between the number of vehicles parked in the vicinity of SkyTrain stations before and after SkyTrain indicates additional vehicles attracted to park-ride opportunities near SkyTrain stations. Figure 5 compares the number of vehicles parked within 200m of selected SkyTrain stations prior to January 1986 when SkyTrain began operation and in March 1986 just prior to Expo 86.

Figure 15



A catchment area of 200 metres was derived from the SkyTrain Rider Survey which found that 95% of park-ride users of SkyTrain parked within 200 metres of a SkyTrain station. The results show an increase of 175 vehicles parked in the vicinity of three stations, 22nd Street, Metrotown and Broadway, 27.6% more than were parked there prior to SkyTrain.

11. TRAVEL BASELINE

11.1 Overview

In order to evaluate SkyTrain's impact, it was necessary to develop a rational and meaningful definition of the term "impact".

"Impact" implies significant change. In order to evaluate an impact, significant changes must be carefully measured. This raises the question, "What portion of measured changes in the environment can be attributed to SkyTrain and how can this change be measured?"

The notion of baseline was introduced as a rational approach for comparing changes due to SkyTrain. Various concepts of baseline conditions were examined to determine the most practical one for measuring SkyTrain impacts.

11.2 Baseline Definition

In essence, a baseline condition reflects the 'normal' condition which would occur in the absence of a new transportation facility. There are several conditions which may be used as baselines as illustrated in Figure 16.

If, for example, a condition such as the traffic volume with SkyTrain is defined as X, the baseline (BL) traffic volumes can be defined as the difference between X and either of two conditions.

BL_0 - 1985 conditions at time (t_0)

BL_1 - regional trend in the condition assuming no SkyTrain ie. bus only transit system.

It is then possible to define the change from the baseline conditions (X - BL) as any of the following:

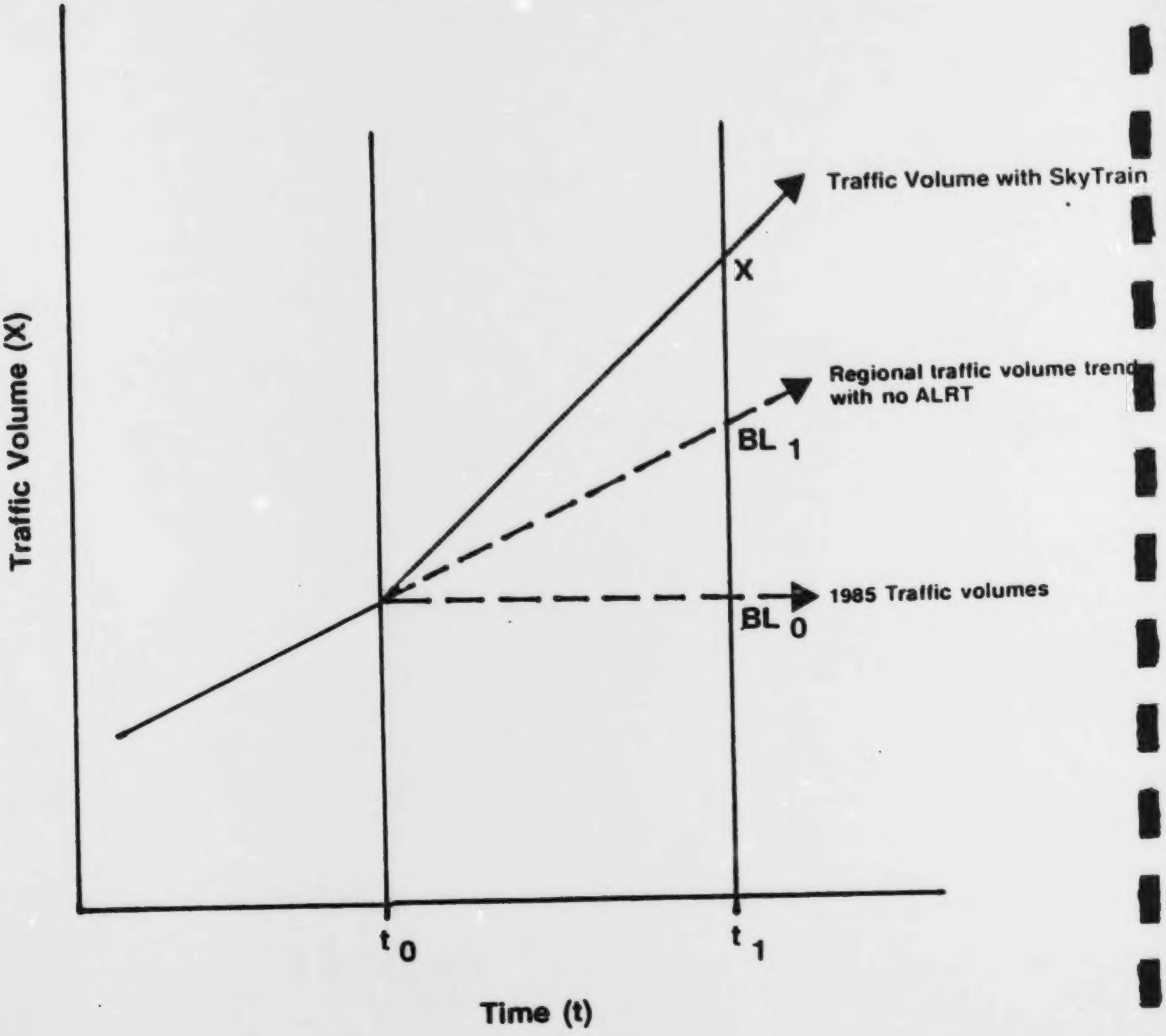
(a) $X - BL_0$ - change from conditions identified in 1985 prior to SkyTrain.

(b) $X - BL_1$ - change from future conditions based on the regional trend assuming no SkyTrain.

For the purposes of the ALRT Impact Assessment the concept of ($X - BL_1$) and in some cases ($X - BL_0$) will be used to define the change due to SkyTrain. The ($X - BL_1$) condition, while moderately difficult to estimate, has the advantage of accounting for the change due to regional

Figure 16

Alternate Baseline Definitions


Traffic Volume with SkyTrain
X
Regional traffic volume trend with no ALRT
BL 1
1985 Traffic volumes
BL 0
Traffic Volume (X)
t 0
t 1
Time (t)

trends distinct from the change accruing as a result of SkyTrain. This is especially important where followup surveys would not be undertaken for some time after the introduction of SkyTrain.

In cases, however, where regional trends may only become manifest in the long term or where followup studies would not be possible except after some years of SkyTrain operation, current conditions may suffice as a reasonable baseline. Thus ($X - BL_0$) would provide a satisfactory definition of a change in baseline conditions due to SkyTrain.

11.3 Baseline Travel Conditions

The baseline travel conditions in the ALRT Impact Assessment establish various characteristics of the urban transportation system in the Vancouver Region. As described in the previous section these can include travel conditions in 1985 prior to the introduction of SkyTrain and future travel conditions based on regional travel trends assuming SkyTrain had not been built. The following identifies the basic components of the travel baseline:

(a) Travel Desires,
(b) Travel Demand,
(c) Transit Ridership,
(d) Parking Demand.

Each of these components is described in the following sections.

11.3.1 Travel Desires

Travel desires as a category of baseline travel impacts refer to the desires of Greater Vancouver residents to travel between areas of the region without reference to route. As trip desires are largely based on land use patterns, the impact of SkyTrain on trip desires would only become manifest over a long period as the increased accessibility offered by SkyTrain influences individual choices on residential location and work place.

Information on baseline travel desires was available from the travel survey through the reporting of trip origins and destinations. Table 40 shows the intermunicipal trip tables (for all trip purposes combined) for all vehicular modes or for transit. These provide baseline data for a 1985 pre-SkyTrain condition. The baseline condition is therefore defined relative to 1985, an $X - BL_0$ definition of baseline. This definition does not account for the influence of regional changes unrelated to SkyTrain.

To establish a baseline which accounts for regional trends, transportation modelling of trip desires in a future scenario with and without SkyTrain could be useful. Travel desires are based on population and employment distribution in the region but are sensitive to the impedence or accessibility between areas. Undertaking a model run for this purpose could establish another baseline condition for future reference.

11.3.2 Travel Demand

11.3.2.1 Overview

More immediate than the impact of SkyTrain on trip desires is its impact on travel demand on the transportation network in the Vancouver area. Changes in travel demand in the region are manifest in the following:

(i) traffic volumes across regional cordons or screenlines,
(ii) mode split region-wide and by corridor.

11.3.2.2 Traffic Volumes

Traffic volumes crossing regional screenlines were surveyed in the screenline survey conducted prior to the opening of SkyTrain. The results of the screenline survey are available in the report "Vehicle and Passenger Screenline Survey." This report provides baseline information on private vehicle and transit passenger volumes across regional screenlines in 1985 for comparison with screenline counts undertaken in subsequent years.

11.3.2.3 Mode Split

Results from the Metropolitan Vancouver Travel Survey provide a profile of mode choice in the Vancouver region by time period as shown in Table 42.

TABLE 41
MODE SPLIT BY TIME PERIOD

MODE	Early Morning (0:00-6:45)	AM Peak (6:45-9:15)	Mid-day (9:15-15:30)	PM Peak (15:30-18:00)	Evening (18:00-24:00)
% by automobile	85%	72%	77%	83%	92%
% by transit	10%	10%	7%	9%	3%
% by walking	2%	14%	13%	5%	3%

Over the course of the typical weekday, 85% of shopping trips (i.e. to shopping) were made by automobile, 6% by transit and 8% by walking. During the mid-day period (09:15 to 15:30), 82% of shopping trips were by automobile, 8% by transit and 9% by walking. During the evening (18:00 to 24:00), 95% of shopping trips were by automobile, 2% by transit and 2% by walking.

The relatively higher proportion of walking and transit trips during the morning peak period reflects the concurrence of travel to work and travel to school. During the morning peak, about 43% of trips were to work and about 30% of trips were to school (including colleges and universities). Of the trips to work during the morning peak, about 83% were by automobile, 4% by walking and 11% by transit. Of the trips to school during the morning peak, about 40% were by automobile, 35% by walking, 12% by transit, 5% by school bus, and 6% by bicycle.

11.3.3 Transit Ridership

11.3.3.1 Annual System Ridership

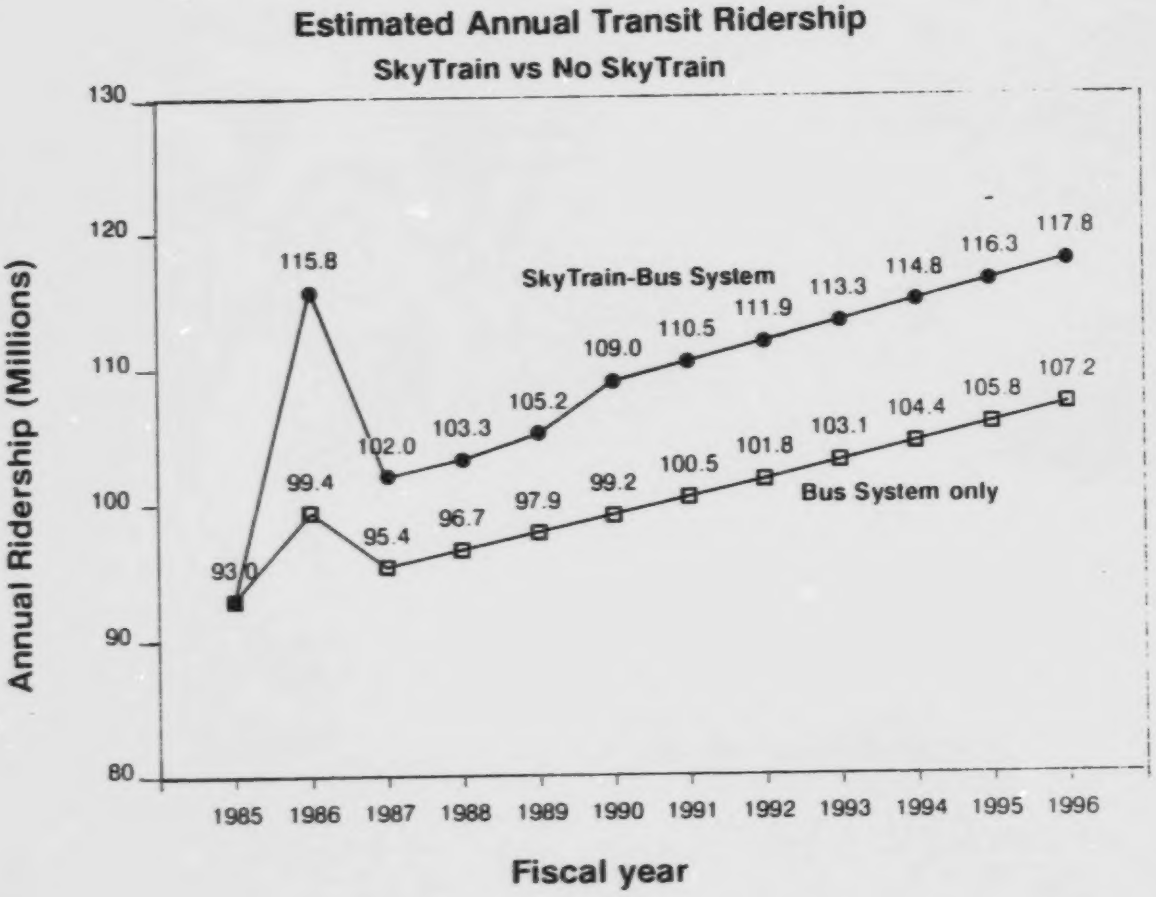
The impact of SkyTrain on overall system ridership can only be determined based on the difference between the regional ridership trend without SkyTrain relative to the regional ridership trends with SkyTrain ie. the comparison based on the X - BL_1 condition.

A comparison of system annual ridership using actual figures for 1985 and 1986 and estimates for the period from 1987 to 1996 is shown in Figure 16. Comparing the annual system ridership for the SkyTrain plus bus system with the bus only (no SkyTrain) scenario indicates that the Phase I line will result in an additional 6.6 million annual transit trips in 1987 and 1988. With the Phase II Surrey extension beginning operation in 1990, ridership would be 9.2 million per year greater than it would be without SkyTrain.

11.3.3.2 Screenline Ridership

Transit volumes collected by the 1985 survey and in a follow-up screenline survey conducted in November 1986 are provided in Figures 17 and 18. These figures compare 1985 and 1986 transit volumes for the AM Peak period and PM peak period respectively. The results show that SkyTrain has contributed to a substantial increase in transit ridership on the Boundary Road (south) and Main Street screenlines. During the AM peak period from the start of service to 9:30 am, transit ridership across the Boundary Road screenline increased by almost 140% from 2180 passengers in 1985 to 5194 passengers in 1986 after SkyTrain began operation. Evening (PM) peak period ridership increased by almost 160% from 2191 to 5671 passengers. At the Main Street screenline into downtown Vancouver, ridership increased by almost 25% during the AM peak period from 12,010 in 1985 to 14,982 passengers in 1986 and by almost 22% during the PM peak period from 11,755 passengers in 1985 to 14,328 passengers in 1986.

Figure 17



Estimated Annual Transit Ridership

SkyTrain vs No SkyTrain

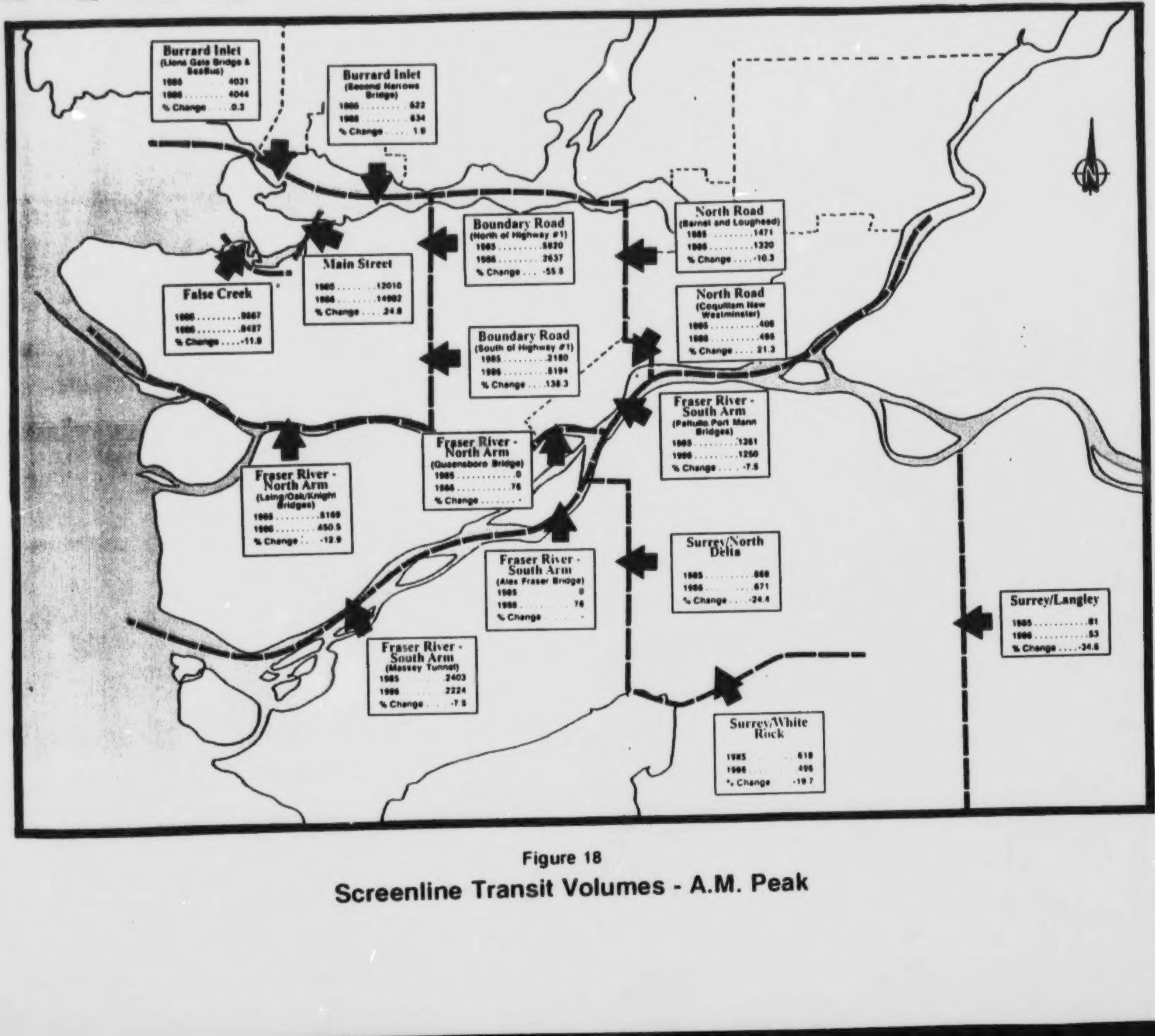

Burrard Inlet
(Lions Gate Bridge & SeaBus)
1985 4031
1986 4044
% Change 0.3
Burrard Inlet
(Second Narrows Bridge)
1985 622
1986 634
% Change 1.9
Boundary Road
(North of Highway #1)
1985 5920
1986 2637
% Change .... -55.5
North Road
(Barnet and Lougheed)
1985 1471
1986 1320
% Change .... -10.3
Main Street
1985 12010
1986 14982
% Change 24.8
False Creek
1985 9567
1986 8427
% Change .... -11.9
Boundary Road
(South of Highway #1)
1985 2180
1986 5194
% Change 138.3
North Road
(Coquitlam New Westminster)
1985 408
1986 495
% Change 21.3
Fraser River - South Arm
(Pattullo, Port Mann Bridges)
1985 1351
1986 1250
% Change .... -7.5
Fraser River - North Arm
(Queensboro Bridge)
1985 0
1986 76
% Change .... -
Fraser River - North Arm
(Laing/Oak/Knight Bridges)
1985 5169
1986 .... 450.5
% Change .... -12.9
Surrey/North Delta
1985 888
1986 671
% Change .... -24.4
Fraser River - South Arm
(Alex Fraser Bridge)
1985 0
1986 76
% Change .... -
Surrey/Langley
1985 81
1986 53
% Change .... -34.6
Fraser River - South Arm
(Massey Tunnel)
1985 2403
1986 2224
% Change .... -7.5
Surrey/White Rock
1985 618
1986 496
% Change .... -19.7
N

Figure 18

Screenline Transit Volumes - A.M. Peak

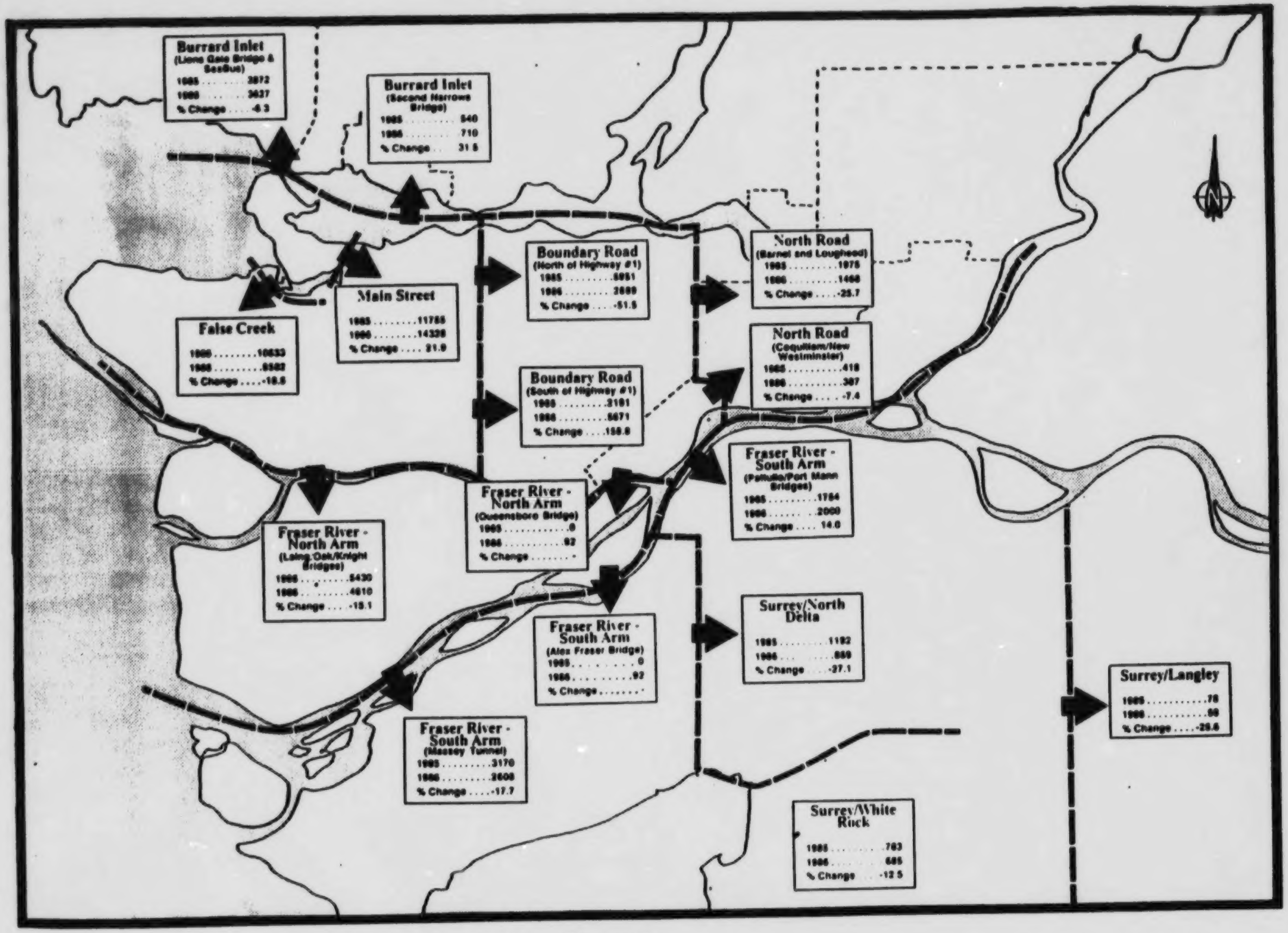

Burrard Inlet
(Lions Gate Bridge & SeaBus)
1985 3872
1986 3627
% Change ..... -6.3
Burrard Inlet
(Second Narrows Bridge)
1985 540
1986 710
% Change ... 31.5
Main Street
1985 11755
1986 14328
% Change 21.9
False Creek
1985 10633
1986 8582
% Change ....-18.6
Boundary Road
(North of Highway #1)
1985 5951
1986 2889
% Change .... -51.5
Boundary Road
(South of Highway #1)
1985 2191
1986 5671
% Change 158.8
North Road
(Barnet and Lougheed)
1985 1975
1986 1468
% Change .....-25.7
North Road
(Coquitlam/New Westminster)
1985 418
1986 387
% Change ..... -7.4
Fraser River - South Arm
(Pattullo/Port Mann Bridges)
1985 1754
1986 .... .2000
% Change 14.0
Fraser River - North Arm
(Queensboro Bridge)
1985 0
1986 92
% Change .... -
Fraser River - North Arm
(Laing Oak/Knight Bridges)
1985 5430
1986 4610
% Change .... -15.1
Fraser River - South Arm
(Alex Fraser Bridge)
1985 0
1986 92
% Change ....-
Fraser River - South Arm
(Massey Tunnel)
1985 3170
1986 2608
% Change .....-17.7
Surrey/North Delta
1985 1192
1986 869
% Change .....-27.1
Surrey/Langley
1985 78
1986 58
% Change .....-25.6
Surrey/White Rock
1985 783
1986 685
% Change ....-12.5
N

Figure 19

Screenline Transit Volumes - P.M. Peak

11.3.4 Parking Demand

The SkyTrain Parking Inventory provides baseline data (shown in Appendix E.2) on parking availability and utilization in 1985 prior to SkyTrain operations. In any event it is unlikely that regional growth in parking in a small defined area could be practically modelled or otherwise estimated.

Follow-up surveys can be undertaken at regular intervals to identify parking changes over time. These survyes would not account for regional growth in parking around stations. Follow-up surveys undertaken within a relatively short time, however, may provide the most reliable comparisons before land use changes would introduce intervening variables to affect parking demand over time.

12. SUMMARY AND CONCLUSION

12.1 Summary

12.1.1 Overview

Specific results of the Metropolitan Vancouver Origin-Destination Survey, e.g. trip rates per person or per household, travel composition data etc., were reported in earlier chapters. These results can be referred to by people in Greater Vancouver and elsewhere who seek specific data for analysis or comparison purposes. In addition, the data bases containing survey-derived data can be readily addressed quite flexibly to obtain other results in formats that might better fit the enquirer's needs.

It is not the purpose of this report to draw conclusions from the data but to establish baseline information for an assessment of the travel impact of the ALRT system in the Vancouver area.

Instead of repeating the various charts and tables of numeric results, it is perhaps more useful in this Summary section to review the various lessons that were learned regarding the process of conducting the Survey. These lessons may be applied by persons in other areas who contemplate conducting a travel survey, or by persons in Greater Vancouver who may be repeating or updating the Survey at some future date.

12.1.2 Metropolitan Vancouver Origin-Destination Survey

12.1.2.1 The Choice of Survey Instrument

In the Metropolitan Vancouver Origin-Destination Survey, several survey instruments were used: telephone interviews; three-day mail-back diaries; one-day mail-back diaries; "roadside" interviews.

As a first observation, it can be said that an objective and comprehensive Feasibility Study and/or Study Design can greatly assist choosing the best survey instrument(s), especially when the eventual survey is to be a collaboration of various parties. The report prepared by Dr. Steuart for the Vancouver project helped to establish a common view among the participants as to the expected outcome, cost and process of the eventual Survey, even though not all of Dr. Steuart's recommendations were implemented. Other survey projects in other areas would benefit by first preparing such a "game plan".

Of course, a telephone survey was chosen as the principal instrument in the Metropolitan Vancouver Survey. The following advantages and drawbacks were discovered or confirmed:

(a) Responses were obtained from about 60% of all households that we attempted to contact in the telephone survey, or from about 75% of households where successful contact was made. By way of comparison, about 50% of households who said they would complete three-day travel diaries actually did provide some completed diaries, although in some of these cases, diaries for some household members and/or some survey days were missing. Return rates from the one-day mail-back diary surveys were, respectively, about 25% for the survey administered at the roadside cordon count stations and 20% for the Survey of Travel for Work and Business Purposes.

(b) The benefit and utility of using listed telephone numbers as the source of sample was clearly demonstrated. Telephone ownership is virtually universal. Residences can be distinguished from other establishments.

After adjusting the "draw rate" for households with unlisted numbers, listed numbers from each exchange area could be sampled randomly and in proportion to the area's population, resulting in a stratified master sample with minimal spatial bias. And, as shown in Sections 3 and 4, the care and precision that went into drawing the sample of households paid off in the close matches between various sample and population profiles that were obtained.

(c) It is acknowledged that the proportion of sampled persons reporting "no trips" - about 20% - seems high, suggesting that this was an easy means for people to avoid participating in the telephone interview. On the other hand, the telephone interview procedures ensured that all household members were surveyed and that data on the persons and households and their trip-making was as completed as possible. By contrast, the mail-back diary results are tinged with problems of incompleteness, namely where some persons in sampled households did not return diaries and where missing responses cannot be distinguished from null responses.

In the design of both survey components, procedures were put in place whereby surveyed households would be called back to obtain missing data. In the actual execution of the surveys, it proved to be an awkward and unproductive process to attempt to call back households for missing data if more than a day or so had passed. (For example, it was sometimes up to two weeks after their completion that diaries would be received and inspected by the survey team, despite the team's best efforts.) This indicates to the importance of the editing and inspection procedures that were set up for the telephone interview survey, procedures that led to relatively "immediate" call-backs to obtain missing data.

(d) Higher trip rates were reported in the diary survey compared with the telephone survey for off-peak, non-home-based and, generally, "more incidental" trips. By contrast, higher trip rates were reported in the telephone survey for habitual, "important" trip purposes such as the trips to and from work and education. In fact, without any further adjustment except the sample-to-population expansion, the assigned trip table of telephone survey results for the AM peak hour produced screenline totals that matched very closely with observed total volumes counted at major and minor screenlines.

(e) A telephone interview survey is not a good instrument for measuring the extent of travel for work or business purposes. The telephone interviews can identify the sub-set of people who travel extensively for work or business purposes, but this sample is "second order small". (In our survey, about 4% of the surveyed households - themselves a 5% sample of CMA households - had one or more members who travel extensively for work or business purposes. If the 20% response rate to our one-day mail-back survey of business travellers is indicative of the response that can be expected, it seems clear that a high sampling rate of truckers, delivery persons and other commercial travellers will be required.

In summary, several features of the telephone interview survey method - or at least the method used in the Metropolitan Vancouver Survey - recommend themselves. Relative to mail-back diaries, the telephone interviews led to higher response rates and "fewer missing pieces" in terms of unaccounted for persons and missing specifications. Only a face-to-face home interview survey, it would seem, could have achieved such high response and completeness rates, but likely at a much higher cost and effort. Being based on residential telephone number, both the telephone interview and travel diary surveys achieved a close representation of the population in both their overall and realized samples.

Results from the telephone survey have been found to be satisfactory for the purposes of modelling peak-hour generations, distribution and modal split. Accordingly, as the principal instrument of origin-destination surveys in other areas or of future surveys in Metropolitan Vancouver, the telephone interview method should receive strong consideration.

12.1.2.2 Survey Design Features

Several useful lessons were learned during the course of the data collection, editing and analysis phases of the Origin-Destination Survey as follows:

(a) In any telephone interview survey, a decision must be made regarding how much effort should be applied to "chase down" absent/non-responding households. The results showed that there were no significant differences between the reported trip rates of households that were reached on the first attempt versus those that were reached on the second or third attempt. It would seem, therefore, that extraordinary efforts to reach absent households are note required for fear of somehow under-representing the "heavy travellers". Similarly, while it is true that telephone interviews conducted only in the evening will miss those who work and play at night, our results show that this problem is not of sufficient magnitude to warrant the extra expense and lower response rates associated with conducting interviews during normal working hours on weekdays.

(b) The results confirmed what might be called a "diligence fall-off" in the results of the three-day diaries. Namely, reported trip rates for Day 3 were lower than those for Day 1 and Day 2 by a statistically significant amount. The longer the called-for reporting period, the higher will be in the incidences of outright refusals to participate in the diary survey and of incomplete or unreturned forms from those who originally agreed to participate. This should give pause to anyone considering a diary survey of longer than one day's duration.

In his feasibility study, Dr. Steuart proposed that automated procedures be established to edit and geo-code the telephone survey data in one step. Several different automated procedures were eventually set up to assist our editing and geo-coding tasks but it was not possible (at least within the available time) to set up a one-step process. Our experience suggests that fully automatic and "immediate" geo-coding may be unachievable. (It presupposes that complete and error-free AMF files exist to geo-code addresses, and that comprehensive files of "monument" and intersection geo-codes also exist.) This being the case, a considerable complexity and expense of system design is avoided when, from the outset, the editing and geo-coding systems are set up to be separate systems.

(c) The size of the data base management and editing and geo-coding tasks can be scaled from the following numbers. The telephone interview survey obtained completed interviews from 25,180 households who provided data on approximately 177,000 trip segments made by approximately 66,800 people. Storage requirements prior to the completion of editing and geo-coding were approximately 45 megabytes. Of the 354,000 trip segment ends, about 40% were the home location, known by address, and about 5% of specifications were other specific addresses; about 30,000 separate addresses had to be geo-coded. About 30% of specified trip ends were place names (monuments) with about 16,500 different places being named. About 20% of specifications were street intersections, with about 11,500 different ones being named. The remaining 5% of specifications were a combination of imprecise specifications (e.g. Downtown, North Shore), "Refused" and "Unknown" specifications, and various oddities. If a similar survey were to obtain data from X% more of fewer households than the Vancouver survey, the number of addresses to be geo-coded would likely also be X% more or fewer. Given the multiple references to place names and intersections, a doubling of the "size" of the survey would not likely double the number of place names, intersections and "other" locations to be geo-coded, but neither would a halving of the survey size lead to a halving of this part of the geo-coding task.

(e) Our geo-coding procedure was first to specify the Universal Transverse Mercator (UTM) coordinates of the trip end and then to locate these coordinates within the appropriate traffic zone. It would have been simpler and faster merely to locate the trip ends within the traffic zone. The rationale for making the extra effort is a good one, namely so that survey results might be compared with other data using a different zone system, or that survey records within specified bands or radii zone system from special points of interest might be summoned. Nevertheless, such opportunities or requirements have not yet arisen, and it remains to be seen whether the extra effort will be recouped.

(f) The telephone survey was completed without any scandal or negative publicity. This reinforces the importance of having municipal officials and police departments informed and "on side", and of preceding the telephone contact with an informative and readable letter of introduction. The device of naming a person to call for further information or to register complaints - our fictitious Barbara Kelly - can also be recommended.

(g) At 5%, the sampling rate for the Metropolitan Vancouver survey was chosen to achieve a sufficient sampling of transit trips and to obtain the first complete all-day "snapshot" of urban travel in many years. The results have been found to be adequate for modelling trip generation, trip distribution and modal split. Smaller samples of different survey instruments might be chosen in other areas. For example, disaggregate trip generation and mode choice analysis could be accomplished with a much smaller sample, and a focus on peak period travel would also have needed a smaller data set.

12.1.3 SkyTrain Rider Survey

The SkyTrain Rider Survey provides a detailed analysis of the personal characteristics, travel behaviour and attitudes of SkyTrain rider. It thus provides a useful database to assess the impact of SkyTrain on those residents who ride SkyTrain. In documenting the impact of SkyTrain on people in the Vancouver region, the survey is limited in its scope in that it does not reflect the characteristics and views of those who do not use the SkyTrain system. Surveys, particularly the household interview type, will be required to fill these information needs which are also important to the assessment of the impact of SkyTrain.

12.1.4 SkyTrain Parking Survey

The approach used in the SkyTrain Parking Survey was somewhat time consuming primarily due to the size of the area inventoried, namely parked vehicles and parking spaces within a 1 kilometre radius of the SkyTrain stations. The results of SkyTrain Rider Survey, however, indicate that 95% of all park-ride vehicles are found within one-third kilometre or 2 blocks from a SkyTrain station. Future surveys might consider reducing the survey area. Data collection required an "on the ground" inventory of parking spaces and parked vehicles. In retrospect an aerial photographic survey may have been more cost-effective although this approach would have involved a trade-off between internal staff costs and the costs of external services.

12.2 Conclusion

In Greater Vancouver, the responsibility for transportation planning is split among several jurisdictions. A consequence of this institutional fragmentation had been a "fragmented database" with different jurisdictions having incomplete, crudely-estimated or, often, conflicting measures of various phenomena under joint consideration. As well, the lack of a comprehensive and reliable data base for transportation, planning may sometimes have delayed joint action on shared problems or led to the wrong diagnosis of symptoms and potential cures.

As a direct result of the ALRT Impact Assessment project there now is one common, comprehensive and accepted data base on travel in the metropolitan area that is accessible to and used by all parties in examining local and regional transportation issues. This data base is also being used to calibrate the regional GVRD forecasting model as well as the local or sub-area models, thereby achieving a common base and analytic tool for examining future conditions and for evaluating alternative projects, policies or strategies.

Transportation planning in Greater Vancouver must be on a consensus basis, requiring the full cooperation and participation of the municipalities in formulating strategies, identifying alternatives, endorsing joint strategies and implementing the solutions or action plans. The muncipalities' willingness and commitment to participate in these processes has been demonstrated in the past, notably by the participation of municipal staff in the design and execution of the surveys and by the muncipalities' provision of funds for the project. The product of these past efforts provides a foundation for future consensus-building and joint action.

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APPENDIX A

STATUS REPORT OF THE TRANSIT TECHNICAL COMMITTEE (TTC) SUBCOMMITTEE

July 1984

(This status report written in 1984 outlined
the activities of the TTC subcommittee,
a group convened to examine the need
for a regional travel study.)

STATUS REPORT OF THE TTC SUBCOMMITTEE
JULY 1984

1. Background

Planning for both road and transit systems requires data on the origins and destinations of existing travel to establish a baseline for prediction of the magnitude and distribution of future transportation movements. Concern over the lack of current data on travel patterns prompted BC Transit staff to consider undertaking an on-board transit survey throughout the Vancouver Regional Transit System. On-board transit surveys, however, while providing current data on transit trips, are limited in their capability to represent travel patterns by the following factors:

(a) The most important information obtainable from on-board transit surveys is origin-destination data. Other information is often considered desirable but is seldom used. The origin destination pattern, sampled by an on-board survey however, is highly dependent on transit system structure and is therefore very sensitive to major system wide changes such as the startup of ALRT operation. Survey information could therefore become outdated after 1986.

(b) A transit survey does not provide any information on travel patterns of automobile trips which comprise 90% of all trips and are the major source of future transit riders.

Recognizing these limitations, it was decided to determine the degree of interest in undertaking a regional travel survey of trips by all modes for a full day. Preliminary analysis indicated a home interview survey could cost approximately $200,000. The higher costs and broader benefits of a regional survey suggested the need for participation by other agencies notably the GVRD, the City of Vancouver and the Ministry of Transportation and Highways.

Subsequently in November 1983 a proposal from BC Transit for a regional travel survey using a telephone interview approach was brought for consideration to the Transit Technical Committee (TTC).

The TTC agreed on the desirability of a regional travel survey and decided to form a subcommittee to coordinate the task of survey development and implementation.

2. Subcommittee Activities

At its initial meeting in December 1983 the Subcommittee considered terms of reference which outlined the following objectives:

(a) To assess the data needs of the various provincial, regional and municipal transportation agencies

(b) To evaluate the various survey approaches available to satisfy these data needs

(c) To develop an appropriate survey design, with consideration of timing and funding

(d) To coordinate the implementation of the survey including data collection, analysis and reporting

The subcommittee pursued these objectives at monthly meetings throughout the first half of 1984 completing items i) and ii) and most of item iii). The following describes the activities of the subcommittee in each of these areas.

2.1 Data Needs

The initial task of the subcommittee involved in an effort to ascertain the specific needs of the various agencies for transportation data. It appeared that the primary users of the data from a regional travel survey would be BC Transit, the GVRD and the City of Vancouver. The other municipalities did not appear to have a need for survey data as distinct from the transportation modelling needs of the GVRD. Municipalities tended to require more detailed, micro-scale information for traffic operations planning.

The major users of survey data defined their information needs as follows:

(a) BC Transit - required data on trip origins/destinations for all travel modes and daily time periods. More specific data on transit trips such as trip purpose, trip frequency and transfers was also needed for more detailed route planning. Socio-economic data on users would be useful for transit marketing plans. And finally the ALRT Impact Study required base data on travel patterns before and after ALRT begins operations.

(b) GVRD - modelling calibration requires a trip table and data on mode split, trip purpose and trip length frequencies for the AM peak period. It was also noted that the analytic efforts could be expanded to PM peak, off peak, 18 hour, non-home based and non-work trips. Screenline traffic counts and trip behavioural information needs were also identified.

(c) City of Vancouver - major gaps in the City's current data base for both strategic and operations planning activities included information on non-peak, non-work, and non-downtown trips.

In summary it appeared that the "common denominator" was the need for origin-destination information i.e. a trip table for all modes and all time periods. This conclusion established the need for a comprehensive regional travel survey.

2.2 Possible Survey Approaches

Having identified a common need, the subcommittee turned to address the issue of the most appropriate survey approach to fulfill these data needs. Originally four basic approaches were considered. These are outlined as follows:

(a) Home-Based Survey - this type of survey can collect information on travel and socioeconomic characteristics. It can be administered by personal interview, telephone contact or questionnaire mailback.

The comprehensive type of home-based survey covers all modes, all areas and all time periods on a region-wide sample. The more limited survey can be restricted by area, mode or time period.

(b) Employer-Based Survey - these surveys are administered at the destination end of the trip and are therefore restricted to work trips. Since responses are obtained by personal interview, telephone or mailback questionnaire, the information obtainable through the employer-based survey is not restricted to any great degree by time constraints, etc.

Employer-based surveys, however, tend to be limited rather than comprehensive, especially in large urban areas due to the logistical difficulties of sampling a large number of employers.

(c) Trip-Based Survey - the trip-based survey is administered during the trip either at the roadside for auto trips or "on-board" for transit trips. Trip-based surveys are restricted by mode. The roadside survey is usually limited by time period to minimize traffic disruption.

Since response is by either personal contact or mailback questionnaire, the amount of data which can be collected is limited. For this reason, trip-based surveys are generally applied to provide information on a specific transportation issue.

Further consideration led to the rejection of the employer based survey and a narrowing of the range of possible choices to the home interview survey and a trip based approach termed the "sparse matrix" technique.

The sparse matrix technique has two components: a roadside survey and an on-board transit survey. The roadside survey of major screenlines would probably involve distribution of a mailback questionnaire. An on-board transit survey would be undertaken simultaneously with the roadside survey. These two surveys would provide only a partial trip table as automobile trips which do not cross major screenlines would have to be generated from a calibrated transportation model to produce a complete trip table.

2.3 Evaluation of Survey Approaches

Evaluation of the two approaches was based on the following factors:

(a) the results obtained from either approach are probably similar in terms of theoretical validity and sampling accuracy.

(b) the sparse matrix approach could provide a somewhat large sample i.e. 10-15% of hourly trips versus possibly 6-8% for a home interview survey.

(c) the two approaches are comparable in cost (estimated in the range of $300,000-$400,000).

(d) there are significant logistical problems in the administration of a roadside survey involving difficulties in surveying highway traffic, inability to survey after dark trips, etc.

(e) a home interview approach provides survey data on all trips for a full day. The sparse matrix approach relies on model-generated results.

Subcommittee members were divided as to their preference for survey approach. The sparse matrix technique appeared to satisfy the transportation modelling requirements of the GVRD as it provides observed screenline data for calibration. BC Transit staff were concerned that the sparse matrix approach does not provide observed data on "after-dark" trips and shorter "internal" trips which do not cross traffic cordons. The City of Vancouver had some concerns about the accuracy of the results using the sparse matrix approach.

3. Current Status

The efforts of the subcommittee have carried the process to the point where decisions about participation and funding are required. While the Transit Technical Committee was a useful forum to discuss the issues involving a regional travel survey, the implementation phase for a broad data collection program including a travel survey is more appropriately initiated and coordinated by the GVRD. The GVRD has broader interests in overall regional transportation planning and a precedented responsibility for data collection activities.

Accordingly, further work by the TTC Subcommittee should await the outcome of the current efforts of the GVRD to secure participation and funding for a transportation data collection program.

APPENDIX B

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APPENDIX C

SURVEY FORMS

C.1. TELEPHONE INTERVIEW SURVEY

GENERALIZED INTERVIEW SCRIPT (August 28, 1985)

INTRODUCTION:

Hello, I am ____________ calling for Canadian Facts. May I please speak to ____________________.

IF SELECTED RESPONDENT IS UNAVAILABLE:
May I speak to any adult there 18 years of age or older?

REPEAT INTRODUCTION IF APPROPRIATE

IF NO ADULT AVAILABLE, ARRANGE FOR CALLBACK TIME AND DATE

A few days ago you should have received a letter about the Vancouver Metropolitan Origin-Destination Survey. I'm calling to interview you about the travel made by all the people in your household, starting yesterday morning and onward. That is, all travel for (DAY PRECEDING INTERVIEW).

1. Have I reached (READ PHONE NUMBER)?

2. Is the correct address there (READ ADDRESS)?
   IF NOT OBTAIN CORRECTED ADDRESS

3. First of all, how many motor vehicles (of any type) do the members of your household have for personal use? (ie: any vehicle which could be driven today!)

4. How many people normally live in your household?

5a) How many people presently work outside the home (either full or part time)?

b) Are any people in your household employed in the delivery of goods, messages or passengers?
IF YES:
We are doing a separate survey of people employed in this industry. We would like to send him/her a letter about this. What is his/her name? WRITE NAME AND OCCUPATION UNDER COMMENTS. NOTE: FOR TRIPS INTERVIEW FOR THIS PERSON, PROBE TO INCLUDE ONLY THEIR PERSONAL TRAVEL. DO NOT INCLUDE TRIPS MADE AS A DELIVERY PERSON.

6. Starting with you please tell me, one at a time, the first name, age and the sex of each person.

TRIP/SEGMENTS INTERVIEW

I'd like to ask you about all of your travel yesterday in the order of the trips you yourself made from the time you woke up to the time you went to bed again.

IF NO TRIPS RECORD PERSON NUMBER AND '00' UNDER TRIP NUMBER SKIP TO SECTION ON NEXT PERSON'S TRAVEL

Q7 Where did you start your first trip from yesterday? And which municipality is this located in?

▲ Q8 When did you leave ________ to go on (your first)(your next) trip yesterday?

Q9 What was the purpose of this trip?

Q10 What type of transportation did you use (next)?
IF BUS: What is the name and number?
IF NOT BUS/WALK: Were you driver or passenger?

Q11 Did you change (buses) (change to another vehicle) on this trip?

Q12 IF YES:
Where did you change your (bus)(vehicle)(mode)? — IF YES

Q13 Where were you going to on this trip?

REPEAT FOR NEXT TRIP ▲ IF NO NEXT TRIP GO TO NEXT PERSON, AND REPEAT FOR Q 7-13

REFERENCE LISTS FOR RECORDING - AUGUST 29, 1985

RECORD OF CALL

RESULT:

1 NO ANSWER
2 BUSY 1, 2, 3
3 CALL BACK

COMPLETION STATUS:

1 COMPLETE FIRST CALL
2 COMPLETE SECOND CALL
3 COMPLETE THIRD CALL
4 NOT IN SERVICE
5 NEW NUMBER/INVALID
6 REFUSES TO RESPOND
7 LANGUAGE PROBLEM
8 IMPOSSIBLE TO CONTACT (3 CALLS)
9 DATA PROCESSING RETURN

DATE PRIOR:

RECORD MONTH, THEN DAY

MONTH	CODE
AUGUST	08
SEPTEMBER	09
OCTOBER	10
NOVEMBER	11

MUNICIPALITY CODE:

MUNICIPALITIES WITHIN THE GVRD

CODE	NAME
01	BELCARRA
02	BURNABY
03	COQUITLAM
04	DELTA
05	LIONS BAY
06	NEW WESTMINSTER
07	NORTH VANCOUVER CITY
08	NORTH VANCOUVER DISTRICT
09	PORT COQUITLAM
10	PORT MOODY
11	RICHMOND
12	SURREY
13	U.E.L.
14	VANCOUVER
15	WEST VANCOUVER
16	WHITE ROCK
30	ABBOTSFORD
40	CHILLIWACK
41	HARRISON HOT SPRINGS
42	HOPE
43	KENT
31	LANGLEY CITY
32	LANGLEY DISTRICT
20	MAPLE RIDGE
33	MATSQUI
21	MISSION
22	PITT MEADOWS
50	OTHER B.C.
60	OTHER CANADA
70	U.S.A.
80	OTHER WORLD
98	DON'T KNOW
99	REFUSED

I.D. TYPE:

CODE	TYPE
1	ADDRESS
2	INTERSECTION
3	MONUMENT
4	INCOMPLETE DESCRIPTION

DEPARTURE TIME:

CODE	TIME	
0001	ONE MINUTE PAST MIDNIGHT (BEGINNING OF PREVIOUS DAY)	
0030	12:30	
0100	1:00 A.M.	
0230	2:30	
0300	3:00	
0400	4:00	
0500	5:00	
0615	6:15 MORNING	
0700	7:00	
0800	8:00	
0900	9:00	
1000	10:00	
1130	11:30	
1200	NOON	
1300	1:00 AFTERNOON	
1400	2:00	
1500	3:00	
1630	4:30	
1700	5:00	
1800	6:00 EVENING	
1945	7:45 (QUARTER TO EIGHT)	
2050	8:50 (TEN TO NINE)	
2100	9:00	
2200	10:00	
2300	11:00	
2400	12:00 MIDNIGHT	
2430	12:30	LATE AT NIGHT ON THE PREVIOUS DAY*
2500	1:00	
2600	2:00	
2700	3:00	
9998	DON'T KNOW	
9999	REFUSED	

* NOTE - THIS IS TECHNICALLY THE DAY OF THE INTERVIEW AFTER MIDNIGHT.

Origin Description - Only the first origin of the day is recorded for each person. For the majority of respondents, the first trip will start at their home. This is recorded in the following way:

	ORIGIN DESCRIPTION:		
PERSON NO.	ADDRESS, INTERS, MONUMENT	MUNICIPALITY CODE	I.D. TYPE
0 1	H	1 4	3

See code list of municipalities

Home is recorded as a "3".

For any other origin, refer to instructions for recording destination descriptions.

Trip Number - Number each separate trip consecutively, using a two digit number.

ie: 0 1
0 2
0 3 etc.

Start again at trip 01 whenever you start with a new member of the household.

Person No.	Trip No.
01	01
	02
	03
02	01
	02 etc.

If a person made no trips, record this number as 0 0. Even if the person has made no trips, record the origin.

Departure Time - Record the departure time for each trip. Record as a four digit number, using the 24 hour clock. (See code list for times.)

Record the time the respondent left their home (or wherever they started from in the morning) and for each trip until the person has returned home (or wherever they spent the night). This may mean that the last trip commenced after the end of the period we are interviewing about. When this happens, record as follows:

12:30 (after midnight) 2 4 3 0
1:00 (in the morning. 2 5 0 0

Code list is provided for your reference.

When we are interviewing about other members of the household, the respondent may not know the exact departure time. Probe to obtain the respondents best guess (ie: within a half hour). Where this is not possible, record:

"Don't Know" 9 9 9 8
"Refused" 9 9 9 9

Departure time is not required for the second, third, etc. segment of trips with more than one segment.

There are three types of descriptions:

1. Address
2. Intersection (probe for nearest street corner)
3. Monument (the name of a major land mark such as a shopping centre, office building, school, etc.)

Record the destination (or origin) as a monument whenever this is appropriate.

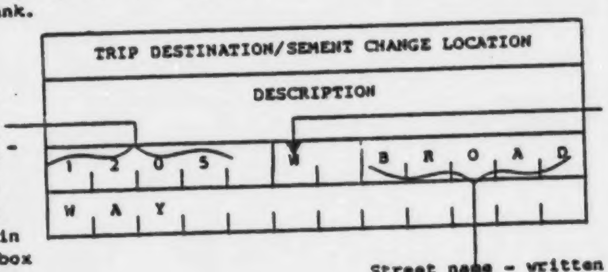
If the destination is not a monument (or very near to a monument) probe and record an address where possible.

If an address is not known, probe and record the nearest intersection.

Note: Probe and phrase your questions to obtain monuments whenever possible. If this is inappropriate, try to obtain an address. Record intersections only if there is no monument and the address is unknown.

Record Addresses As Follows -

Note the two shaded boxes on the top line. Street number goes in the space before the shaded boxes. Direction is recorded in the two shaded boxes. If direction is not recorded, these boxes are left blank.



Record street number - do not record apt. # Start in first box on left.

Direction either:
E
W NE
N NW
W etc.

Street name - written in full.

Start in first box on left after the two shaded boxes.

Notes:
- DO NOT SPELL OUT NUMERIC STREETS
  Record: West Fourth as W 4
  Number Five Road as NO 5 RD
  etc.
- No apartment numbers.
- No punctuation.
- Abbreviate street as ST
  road as RO
  drive as DR
  etc. - use the first two letters of the street type.

As with addresses, abbreviate the type of street, road, etc. using the first two letters.
ie:

ST	Street
RO	Road
AV	Avenue
BO	Boulevard
	etc.

If the precise destination is completely unknown or refused - write under description UNKNOWN or REFUSED, record municipality if possible and record ID type ④ . In this case, probe to obtain as much information as the respondent is able to give you. Record any information you can obtain under "COMMENTS".

Municipality Code -

Record the code for the municipality the destination is located in. (See list of municipality codes.) If you are unable to determine the municipality, record as 9 8 for "Don't Know" or 9 9 for "Refused".

ID Type -

Record the type of description you have used for the destination description. Use the following codes:

1 Address
2 Intersection
3 Monument
4 Incomplete Description

Code ④ is used when you are unable to obtain a specific destination and cannot record an address, intersection or monument.

SURVEY CODE : [illegible]
NAME : [illegible]
ADDR : [illegible]
CITY : VAN BC
POSTAL CODE : [illegible]

TELEPHONE : [illegible]

THE METROPOLITAN VANCOUVER ORIGIN-DESTINATION SURVEY

INTERVIEWER I.D. 50

HOUSEHOLD INFORMATION
NO. OF MOTOR VEHICLES 02
TOTAL PEOPLE IN HHLD 02
TOTAL WORKING 01

PERS. NO.	NAME	AGE	SEX
01		25	1
02		27	1

RECORD OF CALL

CALL TIME	DATE	RESULT
1750	1121	K

COMPLETION STATUS 1
DATE PROC 1.120

PERSON NO	ORIGIN ADDRESS	MUNICIPALITY CODE	ID TYPE	TRIP NO.	DEPARTURE TIME	PURPOSE OF TRIP	TRAVEL MODE USED	DRIVER / PASSENGER	BUS ROUTE USED	SEGMENT NO	DESTINATION ADDRESS	MUNICIPALITY CODE	ID TYPE	COMMENTS DELIVERY TRUCKING TAXI/BUS
														NO
01	H	14	3	01	0700	1	1	1		1	132 st./76 av	12	2	
				02	1030	2	1	1		1	Park Royal S	15	3	
				03	1200	2	1	1		1	13/Lonsdale	07	2	
				04	1300	2	1	1		1	Westview SC	07	3	
				05	1400	2	1	1		1	AMBLESI G	15	4	Ambleside
				06	1500	2	1	1		1	2000 W Broad way	14	1	
				07	1700	7	1	1		1	H	14	3	
				08	1750	4	1	1		1	Coquitlam	03	3	
				09	2130	7	1	1		1	H	14	3	
02	H	14	3	01	1030	2	1	1		1	Cottonwood SC	40	3	
				02	1430	2	1	1		1	200 st.	32	4	
				03	1530	2	1	1		1	Brunette/Mec mot	03	2	
				04	1700	7	1	1		1	H	14	3	

C.2. TRIP DIARY

HOUSEHOLD QUESTION SHEET

1. How many people, including yourself, are living in your household?

THE NUMBER IN THE HOUSEHOLD IS ____________
THE NUMBER UNDER 6 YEARS OF AGE IS ____________

2. How many household members are employed outside the home?
(Consider 20 hours per week to be "full-time")

THE NUMBER FULL-TIME IS ____________
THE NUMBER PART-TIME IS ____________

3. Which description best fits your home?

- ☐ Single detached house
- ☐ Side-by-side duplex
- ☐ Up-down duplex
- ☐ Row house or Townhouse
- ☐ Apartment in a building of less than 5 stories
- ☐ Apartment in a building of more than 5 stories
- ☐ Mobile home
- ☐ Other (specify) ____________

4. Do you own or rent your home?

- ☐ Own
- ☐ Rent

5. How many vehicles do members of your household have for personal use?
(Include cars, vans and light trucks — not collection/hobby vehicles.)

THE NUMBER OF VEHICLES IS ____________
THE NUMBER OF MOTORCYCLES AND SCOOTERS IS ______

6. Please fill in the Make, Model, Year and Distance Driven for each vehicle.
(It does not matter which one you fill in as "Vehicle 1".)

	MAKE	MODEL	YEAR	Distance Driven in last 12 months MILES ☑ KMs ☐	IF OWNED LESS THAN 12 MONTHS Months Owned MONTHS	 Distance Driven MILES ☐ KMs ☐
Example:	VW	Jetta	78	11500		
VEHICLE 1:						
VEHICLE 2:						
VEHICLE 3:						
VEHICLE 4:						
VEHICLE 5:						
VEHICLE 6:						

PERSONAL TRIP DIARY

Start Date: ....

The sponsors listed below are doing a special survey of travel patterns in Metropolitan Vancouver. The purpose of the survey is to obtain information needed for street, road, highway and transit planning. Your assistance by completing this diary, is a very important contribution to this vital community-wide project.

THE METROPOLITAN VANCOUVER ORIGIN-DESTINATION SURVEY

600 - 4330 KINGSWAY, BURNABY V5H 4G8

THE MUNICIPALITIES OF BELCARRA, BURNABY, COQUITLAM, DELTA, NEW WESTMINSTER, NORTH VANCOUVER CITY, NORTH VANCOUVER DISTRICT
PORT COQUITLAM, PORT MOODY, RICHMOND SURREY, VANCOUVER, WEST VANCOUVER AND WHITE ROCK.

B.C. MINISTRY OF TRANSPORTATION AND HIGHWAYS, B.C. TRANSIT, AND TRANSPORT CANADA, WITH THE COOPERATION AND
ASSISTANCE OF GREATER VANCOUVER REGIONAL DISTRICT AND THE B.C. TELEPHONE COMPANY

C.3. EXTERNAL CORDON SURVEYS

TRAVEL QUESTIONNAIRE

Instructions

1. **The driver is asked to record all one-way trips made today (including those which begin and end in the same zone).**

2. **Please use the zone numbers on the map below to identify trip origin and destination points.** Note that downtown Vancouver (zone 3) is a different zone from City of Vancouver (zone 4).

3. **A trip is one-way travel to a destination.** For example, travel from home to work is one completed trip; the next trip would then begin at the work location.

4. This information is for travel analysis only. There is no need to identify yourself by name or address.

Thank you for your cooperation.

	In which map area do you live?	ZONE ____		
	Where did your travel today begin?	ZONE ____		
TRIP 1	Where was your 1st destination?	ZONE ____	Arrival time? ____ AM ____ PM	Purpose of trip? CODE ____
TRIP 2	Where was your 2nd destination?	ZONE ____	Arrival time? ____ AM ____ PM	Purpose of trip? CODE ____
TRIP 3	Where was your 3rd destination?	ZONE ____	Arrival time? ____ AM ____ PM	Purpose of trip? CODE ____
TRIP 4	Where was your 4th destination?	ZONE ____	Arrival time? ____ AM ____ PM	Purpose of trip? CODE ____
TRIP 5	Where was your 5th destination?	ZONE ____	Arrival time? ____ AM ____ PM	Purpose of trip? CODE ____
TRIP 6	Where was your 6th destination?	ZONE ____	Arrival time? ____ AM ____ PM	Purpose of trip? CODE ____
TRIP 7	Where was your 7th destination?	ZONE ____	Arrival time? ____ AM ____ PM	Purpose of trip? CODE ____
TRIP 8	Where was your 8th destination?	ZONE ____	Arrival time? ____ AM ____ PM	Purpose of trip? CODE ____

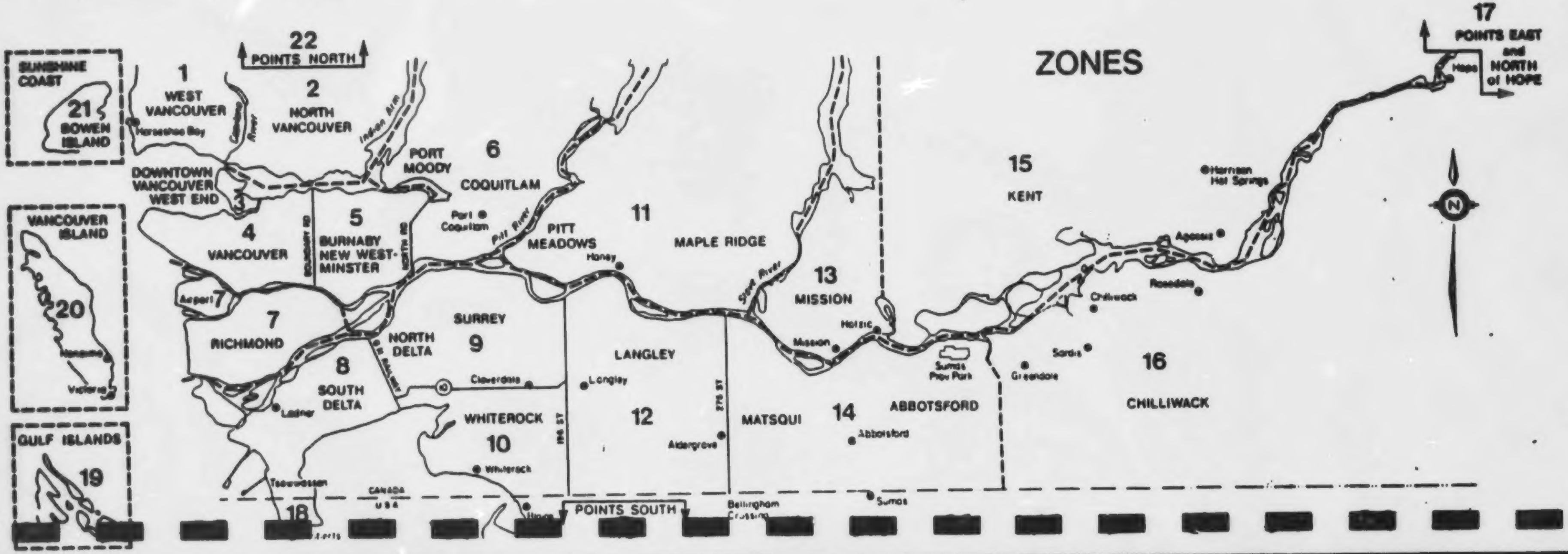
TRIP PURPOSE CODES

A	To work
B	During work
C	Education
D	Leisure
E	Shopping
F	Personal business
G	Delivery
H	To home
I	Other

Which of the above trips were you taking when you received this survey form? TRIP____

How many people were in your vehicle at that time? ____

If you made more trips than space permits please indicate the number not recorded.____


ZONES
22
POINTS NORTH
17
POINTS EAST and NORTH of HOPE
Hope
SUNSHINE COAST
21
BOWEN ISLAND
VANCOUVER ISLAND
20
Nanaimo
Victoria
GULF ISLANDS
19
1
WEST VANCOUVER
Horseshoe Bay
Capilano River
2
NORTH VANCOUVER
Indian Arm
DOWNTOWN VANCOUVER WEST END
3
4
VANCOUVER
5
BURNABY NEW WEST-MINSTER
Airport
7
RICHMOND
8
SOUTH DELTA
Ladner
Tsawwassen
18
PORT MOODY
6
COQUITLAM
Port Coquitlam
Pitt River
PITT MEADOWS
Haney
11
MAPLE RIDGE
Stave River
13
MISSION
Mission
Hatzic
NORTH DELTA
9
SURREY
Cloverdale
10
WHITEROCK
White Rock
LANGLEY
Langley
12
Aldergrove
MATSQUI
14
ABBOTSFORD
Abbotsford
Sumas
Sumas Prov Park
CANADA
U.S.A.
POINTS SOUTH
Bellingham Crossing
15
KENT
Harrison Hot Springs
Agassiz
Rosedale
Chilliwack
Sardis
Greendale
16
CHILLIWACK
N

12-P018F

METROPOLITAN VANCOUVER ORIGIN-DESTINATION TRAVEL SURVEY
BORDER SURVEY

GOOD DAY. WE ARE CONDUCTING A TRAVEL SURVEY FOR THE VANCOUVER REGIONAL DISTRICT. COULD YOU SPARE A MOMENT TO ANSWER A FEW QUESTIONS ABOUT YOUR TRAVEL PATTERNS?

NB (3. TRUCK = DUAL REAR WHEEL OR 3+ AXLES)

5. IN WHICH (MAP) AREA DO YOU LIVE?
6. FROM WHAT (MAP) AREA HAVE YOU JUST COME? (LAST STOP IN CANADA OVER ONE HOUR)
7. WHAT TYPE OF PLACE WAS THAT? (1)PRIV. RES. (2)HOTEL (3)OTHER

THANK YOU VERY MUCH FOR YOUR TIME.

1 REC. NO.	2 TIME BORDER A/P	3 VEH. TYPE 1-CAR 2-TRUCK	4 VEH. OCC.	5 PERM. RES. ZONE NO.	6 TRIP ORIGIN ZONE NO.	7 TRIP ORIGIN TYPE 1-RES. 2-HOT. 3-BUS. OTH.

2-P018D

METROPOLITAN VANCOUVER ORIGIN-DESTINATION TRAVEL SURVEY

OOD DAY. WE ARE CONDUCTING A TRAVEL SURVEY FOR THE GREATER VANCOUVER REGIONAL DISTRICT.
OULD YOU SPARE A MOMENT TO ANSWER A FEW QUESTIONS ABOUT YOUR TRAVEL PATTERNS?

URRENT TRIP

1. FROM WHAT MAP AREA DID YOU COME TODAY TO CATCH THIS FERRY?
2. WHAT TIME DID YOU LEAVE THAT PLACE?
3. WHAT TYPE OF PLACE WAS THAT? (1)PRIV. RES. (2)HOTEL (3)OTHER
4. WHAT IS THE PURPOSE OF THIS TRIP? (1)BUSINESS (2)PLEASURE (3)VISIT (4)RETURN HOME
5. IN WHICH MAP AREA DO YOU LIVE?

EVERSE TRIP (OFFSHORE RESIDENTS)	REVERSE TRIP (MANLAND RESIDENTS)
6. HOW MANY DAYS SINCE YOU LEFT THE ISLAND?	6. IN HOW MANY DAYS DO YOU PLAN TO RETURN?
7. WHAT FERRY DEPARTURE TIME WAS THAT?	7. WHAT TIME OF DAY DO YOU PLAN TO DEPART?
8. TO WHAT MAP AREA DID YOU GO?	8. TO WHAT MAP AREA WILL YOU GO?
9. WHAT WAS THE MAIN PURPOSE OF THAT TRIP?	9. WHAT WILL THE MAIN PURPOSE OF THAT TRIP BE?

HANK YOU VERY MUCH FOR YOUR TIME.

	CURRENT TRIP						REVERSE TRIP				
EC. O.	FERRY DEP. TIME	1 TRIP ORIGIN ZONE NO.	2 TRIP ORIGIN START TIME	3 TRIP ORIGIN 1-RES. 2-HOT. 3-OTH.	4 TRIP PURP. 1-BUS. 2-PLEA. 3-VIS. 4-RET.	5 PERM. RES. ZONE NO.	6 DAYS AWAY	7 FERRY DEP. TIME	8 TRIP DEST. ZONE NO.	9 TRIP PURP. 1-BUS. 2-PLEA. 3-VIS. 4-RET.	10 VEH. OCC.

C.4. SURVEY OF TRAVEL FOR WORK OR BUSINESS PURPOSES

SURVEY OF TRAVEL FOR WORK OR BUSINESS PURPOSES

THE METROPOLITAN VANCOUVER ORIGIN-DESTINATION SURVEY

600 - 4330 KINGSWAY, BURNABY, B.C. V5H 4G8

A

1. ON WHICH DAYS DID YOU OR WILL YOU TRAVEL FOR WORK OR BUSINESS PURPOSES? (THESE PURPOSES COULD INCLUDE MAKING DELIVERIES, MAKING SALES OR SERVICE CALLS, OR OTHER PURPOSES. IF YOU ONLY WENT TO WORK AND CAME HOME AGAIN ON A PARTICULAR DAY, PLEASE DO NOT CHECK OFF THAT DAY.)

1 ☐ MONDAY NOV. 25
2 ☐ TUESDAY NOV. 26
3 ☐ WEDNESDAY NOV. 27
4 ☐ THURSDAY NOV. 28
5 ☐ FRIDAY NOV. 29

2. PLEASE TAKE THIS FORM TO WORK WITH YOU AND FILL IT OUT FOR ONE (1) OF THE DAYS YOU TRAVEL FOR WORK OR BUSINESS PURPOSES. FOR WHICH DAY HAVE YOU PROVIDED INFORMATION?

1 ☐ MONDAY NOV. 25
2 ☐ TUESDAY NOV. 26
3 ☐ WEDNESDAY NOV. 27
4 ☐ THURSDAY NOV. 28
5 ☐ FRIDAY NOV. 29

B PLEASE TELL US ABOUT THE VEHICLE YOU DROVE.

3. WHAT TYPE OF VEHICLE DID YOU DRIVE?

1 ☐ BICYCLE OR MOTORCYCLE
2 ☐ PASSENGER CAR
3 ☐ LIGHT DUTY TRUCK OR VAN (LESS THAN 4500 KG. GVW)
4 ☐ HEAVY DUTY TRUCK WITH 2 AXLES (PLEASE SPECIFY GVW ________________)
5 ☐ HEAVY DUTY TRUCK WITH MORE THAN 2 AXLES. (PLEASE SPECIFY GVW ________________)

4. WHAT IS THE VEHICLE USED FOR MOST OFTEN?

1 ☐ COURIER SERVICE (MESSAGES, DOCUMENTS, SMALL PARCELS, ETC.)
2 ☐ REPAIR OR SERVICE CALLS (TV OR COMPUTER REPAIR, PLUMBER, ETC.)
3 ☐ SALES CALLS (REAL ESTATE AGENT, SALES REPRESENTATIVE, ETC.)
4 ☐ LIGHT LOAD PICK UP AND DELIVERY (BOXES, PACKAGES, ETC.)
5 ☐ HEAVY CONTAINERIZED OR PALLET LOADS
6 ☐ BULK LOADS (GASOLINE, GRAVEL, ETC.)
7 ☐ OTHER (PLEASE SPECIFY ________________________________)

5. WHAT FUEL DOES YOUR VEHICLE USE?

1 ☐ LEADED GASOLINE
2 ☐ UNLEADED GASOLINE
3 ☐ DIESEL
4 ☐ OTHER (PLEASE SPECIFY ________________)

PLEASE TURN OVER AND COMPLETE THE TRIP DIARY

D PLEASE ENTER ANY COMMENTS YOU MAY HAVE IN THE SPACE BELOW

THANK YOU FOR YOUR ASSISTANCE. PLEASE MAIL BACK YOUR COMPLETED FORM IN THE ENVELOPE PROVIDED. IF WE RECEIVE YOUR COMPLETED FORM POSTMARKED NO LATER THAN THURSDAY, DECEMBER 5, WE WILL MAIL YOU TWO (2) EXPO 86 "SCRATCH AND WIN" LOTTERY TICKETS.

THE PERSON IN YOUR HOUSEHOLD WE ORIGINALLY CONTACTED WAS

SHOULD WE MAIL THE LOTTERY TICKETS TO THE PERSON ON THE LABEL?

☐ YES ☐ NO PLEASE COMPLETE THE FOLLOWING

NAME ________________________________

ADDRESS ________________________________

CITY ________________ POSTAL CODE ________________

(FRONT)

TRIP DIARY

C PLEASE PROVIDE INFORMATION ABOUT EACH TRIP YOU MAKE FOR WORK OR BUSINESS PURPOSES. PLEASE INCLUDE SUCH TRIPS AS GOING TO LUNCH THAT ARE MADE DURING YOUR WORKING DAY. PLEASE TELL US THE PLACE AND TIME THAT YOUR FIRST TRIP BEGAN. FOR TRIP ONE (1) AND ALL OTHER TRIPS, PLEASE TELL US THE PLACE AND TIME THAT THE TRIP ENDS. ALSO, AT EACH STOP, PLEASE TELL US HOW LONG YOU STAYED.

PLEASE INDICATE EITHER AN ADDRESS OR THE NEAREST INTERSECTION OR THE NAME OF THE BUILDING (SEARS, BENTALL 2 ETC.) ALSO PLEASE INDICATE THE MUNICIPALITY. HERE ARE SOME EXAMPLES:

TRIP	LOCATION OF TRIP END		ARRIVAL TIME		TIME STAYED
17	GRANVILLE & 12th	VANCOUVER	1:45	☐ AM ☒ PM	15 MIN
18	SEARS	BURNABY	2:30	☐ AM ☒ PM	20 MIN
19	500 4th Avenue	NEW WEST	3:10	☐ AM ☒ PM	10 MIN

6. MILEAGE READING BEFORE START OF FIRST TRIP: ________ ☐ MILES ☐ KILOMETERS

7. TIME AND PLACE OF START OF FIRST TRIP:

____:____ ☐ AM ☐ PM ________ LOCATION ________ CITY

OFFICE USE	TRIP NO.	LOCATION OF TRIP END ADDRESS / INTERSECTION / BUILDING	MUNICIPALITY	ARRIVAL TIME		TIME STAYED
	1				☐ AM ☐ PM	
	2				☐ AM ☐ PM	
	3				☐ AM ☐ PM	
	4				☐ AM ☐ PM	
	5				☐ AM ☐ PM	
	6				☐ AM ☐ PM	
	7				☐ AM ☐ PM	
	8				☐ AM ☐ PM	
	9				☐ AM ☐ PM	
	10				☐ AM ☐ PM	
	11				☐ AM ☐ PM	
	12				☐ AM ☐ PM	
	13				☐ AM ☐ PM	
	14				☐ AM ☐ PM	
	15				☐ AM ☐ PM	
	16				☐ AM ☐ PM	
	17				☐ AM ☐ PM	
	18				☐ AM ☐ PM	
	19				☐ AM ☐ PM	
	20				☐ AM ☐ PM	
	21				☐ AM ☐ PM	
	22				☐ AM ☐ PM	
	23				☐ AM ☐ PM	
	24				☐ AM ☐ PM	
	25				☐ AM ☐ PM	
	26				☐ AM ☐ PM	
	27				☐ AM ☐ PM	
	28				☐ AM ☐ PM	
	29				☐ AM ☐ PM	
	30				☐ AM ☐ PM	
	31				☐ AM ☐ PM	
	32				☐ AM ☐ PM	
	33					

☐ MILES ☐ KILOMETERS

8. MILEAGE READING AT END OF LAST TRIP: ________

PLEASE TURN OVER AND COMPLETE THE REMAINING PORTION OF THIS FORM SO YOUR EXPO 86 "SCRATCH AND WIN" LOTTERY TICKETS CAN BE MAILED TO YOU!

C.5. SKYTRAIN RIDER SURVEY

1. What time did you receive this questionnaire?

Please write time: ________ am or pm

2. Which SkyTrain station did you board at?

Please name station ____________

3. Where did you start this trip?

____

(Please give nearest intersection, building name or street address)

4. How did you get to the SkyTrain station?

1. Bus
2. Walk
3. Drove car and parked
4. Dropped off by car
5. Other; please specify

____

5. If you took a bus to SkyTrain, which route(s) did you take?

1st BUS Route Number ________ and

Route Name ____________

2nd BUS Route Number ________ and

Route Name ____________

6. If you walked to SkyTrain, how many blocks? *Please write number of blocks.*

____

7. Which SkyTrain station will you get off at? *Please name station.*

____

8. What is your final destination?

____

(Please give nearest intersection, building name, or street address)

9. How will you get to your final destination?

1. Walk
2. Bus; please give Route Numbers/Names

____

3. SeaBus
4. Other; Please specify

____

10. What is the main reason for this trip?

1. Work
2. Shopping
3. School
4. Personal Business
5. Social/Recreational
6. Other; Please specify

____

11. Was a car available for this trip?

1. YES 2. NO

12. If you could have used a car for this trip why didn't you?

1. Cost too much.
2. Scarce parking.
3. Heavy traffic.
4. Transit more convenient.
5. Other; Please specify.

____

13. Will you *(or did you)* use SkyTrain to ride in the opposite direction today?

1. NO
2. YES; Please approximate time of day: ________ am or pm

14. If YES and you are returning by SkyTrain, will you transfer to a bus to reach your final destination?

1. YES 2. NO

15. In total, how many transit trips will you make TODAY on... *(please write number of trips in space)*

1. SkyTrain ________ 3. Sea Bus ________

2. Bus ________

16. Which days did you use SkyTrain last week? *Please circle all that apply.*

1. Sunday
2. Monday
3. Tuesday
4. Wednesday
5. Thursday
6. Friday
7. Saturday

17. Please indicate how many one way trips you took on SkyTrain last week. *(e.g. from home to work = 1 trip, from work to home = 1 trip)*

________ trips last week

A 631

18. Before SkyTrain how did you make this trip?

1. Bus; please give Route Numbers/Names ________

____

2. Car
3. Walk
4. Did not make this trip before SkyTrain
5. Other; Please specify.

____

19. Compared with your means of travel before SkyTrain started, has travel time to your destination...

1. Increased by about ________ minutes

2. Decreased by about ________ minutes

3. Remained about the same as before.

Answer questions 20 and 21 if you used a car or other private vehicle to travel to SkyTrain today.

20. Do you usually park...

1. On local streets?
2. Free of charge in a nearby lot/garage?
3. In a nearby lot/garage and pay?

21. Why don't you use connecting bus service to get to SkyTrain? *Please check all that apply.*

1. Don't know about it.
2. Bus route not close enough to home/work.
3. Bus service too infrequent.
4. Transfers are inconvenient.
5. Bus is too slow.
6. Bus is unreliable.
7. Other; please specify.

____

22. Why don't you ride SkyTrain more often when you travel? *Please check all that apply.*

1. More convenient to drive.
2. More convenient to take the bus.
3. SkyTrain is too slow.
4. Parking at SkyTrain stations is difficult.
5. SkyTrain stations are not conveniently located.
6. Don't travel that much.
7. SkyTrain doesn't go where I want to go.
8. I do ride SkyTrain often.

23. Are you...?

1. Male 2. Female

24. What is your age? ________ years

25. Your comments about SkyTrain are valuable to us. How can we improve service for you?

____

____

____

____

____

____

APPENDIX D

DATABASE STRUCTURES

DESCRIPTION OF FILES OF RESULT DATA FROM THE TELEPHONE SURVEY

Two master data bases were created to store the edited data from the telephone survey. One contains the data pertaining to the sample households - name, address, telephone number, data on the household size, car ownership and number of employed persons, data on the age and sex of each household member. It also contains data related to the conditions of the data collection - date of survey, interviewer number, completion status (i.e. whether data was obtained on the first, second or third call) and weather on the date prior to the household's survey. The second master data base contains data pertaining to the trips made by the members of the surveyed household. This data base also contains information such as the text descriptions of the origins and destinations and the origin or destination type (i.e. monument, intersection, address, other); this information was required for geo-coding purposes. The two data bases are linked by the record keys. Both data bases are off-line on tape in secure storage. Together, they require approximately 36 megabytes of storage.

The two permanent master data bases have been compressed and stripped of confidential data to achieve two working data bases for application to transportation analysis and modelling. "OD-DEMO1" contains the household or demographic data. "ODSRVY:TRPSEG" contains the data for reported trips. These two working data bases together occupy approximately 10 megabytes of disk storage.

Description of OD-DEMO1

A more complete description of the fields in OD-DEMO1 follows. Also described is the status of, and procedures for, data editing. Readers should refer to the survey coding form depicted in Appendix C.

Field 1 SAMPLE:

Each household in the survey sample was assigned a five-digit number. This number/key identifies each household record and is the base for the key which identifies each trip segment record.

Field 2 PERSON-NUM:

This two-digit field identifies the number of persons in the household. All records with missing or inconsistent specifications have been inspected and appropriate specifications have been inserted.

Field 3 PER-WORK:

This one-digit field identifies the number of workers in the household (full time or part time). All records with missing or inconsistent specifications have been inspected and corrected.

Field 4 AUTO-NUM:

This one-digit field identifies the number of motor vehicles in the household (cars, motorcycles, trucks and light trucks). All records with missing or inconsistent specifications have been inspected and corrected.

Field 5 TRAF-ZNE:

The UTM's of the household's location were geo-coded and then situated within the appropriate three-digit traffic zone of the GVRD's system of approximately 350 traffic zones.

Field 6 MUNICODE:

Two-digit codes have been used to identify municipalities within the survey area (i.e. the Greater Vancouver CMA) and to identify various surrounding areas. This field identifies the household's municipality of residence.

Field 7 EX-FACTOR:

Preliminary expansion factors have been calculated and inserted into five digit fields in each household record. Results from the 1981 Census and from the 1986 Census provide population totals for each traffic zone. With these totals, the 1985 zonal populations were interpolated to derive the numerator of the expansion factor. The sum by zone of the number of people within sampled households was used as the denominator of the expansion factor.

Field 8 PERSON1:

This one-digit field identifies the sex of the first-named person. (Male = 1; Female = 2; Missing, Refused = 3) Note that PERSON1 is not necessarily the head of household and not necessarily the oldest. (Most often, it was the person answering the interview questions.) The 25,185 surveyed households contained 66,777 persons of which 724 had missing or refused sex specifications.

Field 9 AGE1:

This two-digit field identifies the age of the first-named person. According to the coding conventions, babies less than one year old were to be recorded as being one (to distinguish from missing specifications) and persons whose age was refused or unknown were to be recorded as 98 and 99 respectively. Of the 66,777 surveyed persons, 3,023 persons had missing or refused age specifications.

Fields 10 to 31:

These fields identify the age and sex of other household members.

Description of ODSRVY:TRPSEG

A more complete description of the fields in ODSRVY:TRPSEG follows. The status and procedures for editing are also outlined. Refer to the survey coding form depicted in Appendix C.

Field 1 KEY:

Each trip segment record in the data base is uniquely identified by an eleven-digit key number. The first five digits are the household/sample number (providing the link with OD-DEMO1). The sixth and seventh digits identify the person number. The eighth and ninth digits identify the trip number for that person. The tenth and eleventh digits identify the trip segment number for that trip.

In the main (uncompressed) trip data base, persons reporting that they made no trips on the previous date are identified as XXXXX-XX-00-00, i.e. with the trip and segment fields both zero. (Persons reported as being out of town on the survey day are also identified in the data base by a key such as XXXXX-XX-00-00. The municipality code for the out-of-towners would show an external area rather than the respondent's municipality of residence.) Of the 66,777 persons in surveyed households, 14,029 (21%) reported that they made no trips, and 1001 (1.5%) were reported as being out of town. Records indicating " no trips" were not brought into ODSRVY:TRPSEG, the compressed trip data base.

Data was obtained on approximately 177,300 trip segments. This included 164,360 one-segment trips. There were 5,000 two-segment trips, 860 three-segment trips and 80 trips with four-or-more segments.

Field 2 TIME:

This four-digit field contains the reported start time of the trip segment, using a 24-hour clock. There were 2,293 instances of missing or refused travel time specifications. Inspection of reported trip-start times shows pronounced modalities at the hour and half-hour points, with lesser modalities at the "quarter after" and "quarter to" points.

Starting times for the second, third, etc. segments of multisegment trips were not recorded during the survey interviews. In order that each segment record could "stand alone", an artificial starting time for these trip segments was created by adding 12 minutes to the reported starting time of the preceding segment.

Field 3 TRIP-TIME:

The survey did not obtain data on the duration times for trips. Because this information is useful for modelling purposes, trip times have been calculated and inserted into three-digit fields of so-called Segment 1 records. Zone-to-zone auto times (for drivers and passengers) were derived from the current AM peak hour calibration of the GVRD transportation model. (Intra-zone travel times are calculated to be zero; if the traffic zone of the trip's origin or destination was not known, a missing value code - 999 - was inserted.) Zone-to-zone transit times were also derived from the current calibration and include assumed walk times, wait times and calculated in-vehicle times.

Field 4 TRIP-START-MODE:

The survey allowed for 12 mode specifications (the 11 categories on the survey form plus "public transit" specified after the fact based on inspection of the trip records). The survey also allowed for 3 "method" specifications (i.e. Driver, Passenger, Unknown). These 36 possible combinations have subsequently been compressed to 9 modes:

1 = auto driver (including drivers for the original car, motorcycle, light truck, heavy truck and taxi mode options), 58.8% of all trips

2 = auto passengers (including passengers of the original car, motorcycle, light truck, heavy truck and taxi modes mode options) 21.5% of all trips

3 = transit passenger (all methods), 7.9% of all trips

4 = special bus passenger (all methods), 0.2% of all trips

5 = school bus passenger (all methods), 0.6% of all trips

6 = bicycle (all methods), 9.2% of all trips

7 = walk (all methods)

8 = other (all methods of the original "Other" mode category). Inspection of the 384 "other" specifications in the data base shows that 348 of these trips (91%) were either into or out of the International Airport or the ferry terminals.

9 = unknown, 0.3% of all trips. (This includes the "Don't Know" mode specifications from the survey, plus the "Don't Know" method specifications related to the original car, motorcycle, light truck, heavy truck and taxi modes.)

Field 5 TRIP-END-MODE:

STARTMODE noted above identifies the mode of the first segment of each trip. As a one-digit field in so-called Segment 1 records, ENDMODE identifies the mode of the last segment of the trip. This provides a basis of comparison to identify instances of park-and-ride, kiss-and-ride and bus-to-auto shifts. Note that, under the recording conventions, walking to or from car parks or bus stops was not recorded as a trip or trip segment.

Field 6 PURPOSE-FROM-TO:

The survey allowed for 9 categories of trip purpose. They are:

1 = to work

2 = during work

3 = to education

4 = to leisure/family activities

5 = to shopping

6 = to personal business

7 = to home

8 = to serve a passenger

9 = don't know or refused

As can be seen, these trip purposes are "to" purposes. Subsequently, the data has been processed to derive "from-to" trip purposes. This was done by inspecting either the trip origin description or the trip purpose of the preceding trip. The result is a set of 81 trip purposes, that is to say, a 9 by 9 matrix of trip purposes built from the activities associated with the original nine trip purposes. In this two-digit field, for example, a specification "71" identifies a trip from home to work.

Field 7 SEX:

The one-digit sex specification of the trip maker has been copied from the corresponding household record.

Field 8 AGE:

The two-digit age specification of the trip maker has been copied from the household record.

Field 9 ORIGIN-ZONE:

The three-digit traffic zone number of each trip's origin is specified in this field. If the proper traffic zone could not be identified, the two-digit municipality code is instead inserted in this field. Or, if the proper municipality code could also not be identified, the default code "99" has been inserted.

Of the approximately 340,600 trip ends in the data base (corresponding to the 170,300 trips), about 14,000 trip ends have not been located within three-digit traffic zones. Computer routines have been written to distribute "two-digit trip ends" among the appropriate municipal three-digit traffic zones during the preparation of zone-zone trip tables.

Field 10 DESTIN-ZONE:

This field contains the three-digit specification of the traffic zone of each segment's destination. As with segment origins, two-digit municipality or default codes are inserted if the proper three-digit code could not be determined.

In so-called Segment 1 records, the field has been overwritten so as to contain the destination of the trip end. This step was invoked so that analysis could be undertaken without having to trace through the chain of trip segments to determine the destination of multi-segment trips each time the data base is addressed. As indicated above, the vast majority of trips are one-segment trips anyhow. The description of Segment 1's destination can be "recovered" from the description of Segment 2's origin.

Field 11 ORIGIN-MUN:

This field contains the two-digit municipality code of the trip origin (or 99 if unknown). This field facilitates the tabulation of data on a municipality-by-municipality basis.

Field 12 DESTIN-MUN:

This field contains the two-digit municipality code of the end point of the trip segment. For Segment 1 records, the trip destination replaces the trip segment end point.

Field 13 EXPANSION-FACTOR:

The 5-digit survey expansion factor is brought forward from the household record and is inserted in each trip segment record.

*****Note that Fields 14 through 22 described below are overlays of some of the fields described above.*****

Field 14 SAMPLE-KEY:

The five-digit household/sample number of the segment record key is addressable as a separate field.

Field 15 PERSON-NUMBER:

The two-digit person number of the segment record key is addressable as a separate field.

Field 16 TRIP-NUMBER:

The two-digit trip number of the trip segment record key is addressable as a separate field.

Field 17 SEGMENT-NUMBER:

The two-digit segment number of the trip segment record key is addressable as a separate field.

The compressed ODSRVY:TRPSEG data base has been set up to facilitate analysis of reported trips. As noted previously, the destination and final mode of the trip have been patched into fields of Segment 1 of each trip. Thus, information describing the overall trip - the time, location and mode at the origin and destination, the trip's purpose - is contained in fields of Segment 1 records. It is not necessary to trace through the chain of trip segments when tabulating trips of various types or when building trip tables. When using the data base for analysis of trips, it is merely necessary to impose the criterion that the Segment Number must be equal to 1 in order for the record to be selected. The same data base can still be used for inspection of the segments of multi-segment trips.

Field 18 PURPOSE-FROM:

This one-digit field essentially describes the activity at the trip origin, derived from one of the nine trip purpose categories of the survey.

Field 19 PURPOSE-TO:

This one-digit field contains the trip purpose according to one of the nine "to" purposes of the telephone survey. It describes the activity at the trip destination.

Field 20 ORIGIN-AREA:

The traffic zones of Greater Vancouver - about 350 in all - have been grouped into 9 superzones. For example, all traffic zones in downtown Vancouver begin with the number 2 (210, 217, etc.). This one-digit field identifies the superzone of each trip's origin, providing a third means of easily grouping and tabulating the data, along with zone by zone and municipality by municipality groupings.

Field 21 AREA-DESTIN:

The superzone of each trip's destination has been inserted into this one-digit field in Segment 1 records.

Field 22 TIME-INTERVAL:

The ten-minute interval of the trip's starting time is inserted in this field, obtained by truncating the final digit of the four-digit trip start time (e.g. 07:15 becomes 07:1).

DESCRIPTION OF FILES OF RESULT DATA FROM THE TRIP DIARY SURVEY

Chapter 4 presents some of the results of the trip diary survey as well as some of the preliminary analyses of the results. This appendix describes the data files that contain those results.

Six files of result data were produced. The DIARY-HOUSEHOLD and DIARY-PERSON files, respectively, contain responses to the question on the "Household Question Sheet" and "Preliminary Diary Questions" survey forms. A total of 1,704 households and 3,707 persons provided diary data. (See Appendix C2.) In addition, four files containing trip-related data were created, as follows:

- DIARY-TRIP contains all trip-related data reported by all persons for all three of their "diary days". A total of 37,034 trip records are in this file.
- As is noted in Chapter 4, three-sets of three-day diaries were used, with Monday, Wednesday and Friday being "Day 1" of each set. It was also noted in Chapter 4 that reported trip rates decreased for "Day 3" compared with "Day 1" and "Day 2" rates. Accordingly, DAY 1 contains only trip data reported for "DAY 1", a total of 13,566 records. Since reported trip rates for Monday and Friday were about one trip per household lower and higher, respectively, than Wednesday rates, and since DAY_1 contains Monday, Wednesday and Friday trips in roughly equal proportions, DAY-1 can be used for analysis of the "typical weekday".
- In addition to "Day of Diary", the "Day of Week" is identified as a field in each trip record. The SATURDAY file was created on this basis; it contains 4,039 records.
- The SUNDAY file contains 2,877 records.

Each of the six files is available from the GVRD Development Services Department in ASCII, SPSS-PC or Userbase format. (Userbase is a database program for VAX computers.) Vancouver-area clients can have on-line database inquiry and report-generation.

Figures D1, D2 and D3, respectively, present the field names and field descriptions for DIARY-HOUSEHOLD, DIARY-PERSON and DAIRY-TRIP. (DAY-1, SATURDAY and SUNDAY were derived as subsets of DIARY-TRIP and hence have the same features.) Again, the reader should refer to the survey forms in Appendix C2. For most data fields, the coding directly reflects the choices that were offered to the respondent. In the following paragraphs, a commentary is presented on the contents or format of particular fields that contain modified or non-obvious codings.

Four comments of an overall nature apply:

- Some survey questions were answered by checking a box. These responses have been assigned a numeric value, starting from 1, in the order listed in the question. For example, for Question 4 on the "Household Question Sheet", the response "Own" is assigned the value 1, and the response "Rent" is assigned the value 2.

- Missing or incomplete specifications for numeric fields have been filled with 9's. (This includes fields which become numeric after coding such as the Own/Rent example presented above.) There has been no attempt to edit text fields.

- As was noted in Chapter 4, one problem in using the diary survey results is to distinguish the null responses form the non-responses. That is to say, some respondents may have left blank the responses to certain questions that they feel did not apply to them.

- As can be seen in Figure E3, pertinent data from DIARY-HOUSEHOLD and DIARY-PERSON has been patched forward into DIARY-TRIP. This will allow the user to conduct different types of analysis using DIARY-TRIPS without the need to link to the other files. Note, however, that all the files can be linked based on a key that builds progressively from the sample/household number, the person number, the day of diary number and trip number.

DIARY-HOUSEHOLD:

Field 1. SAMPLE:

As noted above, the five-digit household number is used to distinguish household records. The household key becomes the foundation of the six digit person number in DIARY-PERSON and of the nine-digit trip number in DIARY-TRIP.

Field 2. HOME-MUN:

The municipality of residence of the household has been coded using a two-digit code.

Field 11. NUM-DIARY:

The number of diaries received from the household can be compared with the difference between NUM-HOUSE (Field 3) and NUM-SIX (Field 4) to determine if every person who should have returned a diary did indeed return one. Of course, further inspection may be needed to determine if returned diaries are complete and error-free.

Fields 12 through 16:

Refer to Question 6 on the "Household Question Sheet". The text field VI-MODEL combines the response of Question 6 regarding Make and Model. VI-UNITS indicates whether to scale the response to VI-DIST is in miles (1) or kilometres (2). VI-MONTH would be used to factor up VI DIST (i.e. by 12/VI-MONTH). Note that there has been no analysis of these fields, and they do contain many instances of missing specifications.

DIARY-PERSON:

Field 9. INDUSTRY:

Fourteen choices were offered. Code 16 has been used to identify instances where there were multiple specifications. Code 99 has been used to denote missing specifications.

Field 11. START:

The day of the week on the person began to record trips has been patched into this field, with Monday as Code 1.

Fields 12, 13, 14:

The number of trips that the person reported over each of their three diary days has been patched into these fields.

Fields 15, 16, 17:

The origin description of the person's first trip on Day 1 has been patched into these fields. ADDRESS is a text field. ORI-MUN is a two-digit numeric field containing a municipality code. ADD-TYPE refers to whether ADDRESS in an intersection, landmark or specific address.

DIARY-TRIP:

Fields 1, 2, 3, 4:

Taken together, the nine-digits of these four fields comprise the unique register or identifier for reach record in DIARY-TRIP. The five-digit SAMPLE key, and the six digit key created by SAMPLE AND PERSON provide references, respectively, to the DIARY-HOUSEHOLD and DIARY-PERSON files.

Fields 6, 7, 8, 9, 10, 11, 12, 13:

These fields have been patched forward into DIARY-TRIP from the trip-maker's household record in DIARY-HOUSEHOLD.

Fields 14, 15, 16, 17, 18, 19, 20, 21:

These fields have been patched forward into DIARY-TRIP from the trip-maker's personal record in DIARY-PERSON.

Field 22. DEPART:

The departure time at the trip origin is coded using a 24-hour military clock. Missing departure times specifications are coded as 9999.

Fields 23, 24, 25, 26:

ORI-MUN and DES-MUN, respectively, are two-digit codes identifying the municipality in which each trip began and ended. DESTIN-ADDRESS is a text field containing the respondent's destination specification. DES-ADD-TYPE indicates whether the specification identifies a monument, intersection or specific address.

Field 27, 28, 29 PURPFROM, PURPTO, PURPOSE:

Question 5 on the "Trip Description Page" (see Appendix C2) allowed the respondent to check one of eleven categories to describe the purpose of the particular trip. These trip-purpose choices are registered in PURPOSE, but they are not identical to those offered in the Telephone Survey, thereby creating problems of comparability. Accordingly, responses to Question 5 were recoded to create PURPTO. The recoding format, and the resulting correspondence to trip purpose categories of the Telephone Survey, are as follows:

Telephone Survey Trip Purpose Codes

1. To Work
2. During Work
3. To Education
4. To Leisure
5. To Shopping
6. To Personal Business
7. To Home
8. To Serve Passenger
9. Unknown, Missing

Trip Diary Codes

PURPOSE		PURPTO
1.	Going to work	1
2.	Part of my work	2
3.	To School or training	3
4.	Leisure or social	4
5.	Going Shopping	5
6.	Personal Business	6
7.	Going to eat out	4
8.	Giving someone a ride	8
9.	Accompanying driver	4
10.	Going home	7
11.	Other	9

Both PURPOSE and PURPTO essentially describe the destination of the trip (to work, to school, etc.). PURPFROM was created by inspecting other data fields describing that trip's origin and/or the previous trip's destination. As a result, eighty-one possible trip purpose combinations (9X9) can be obtained by combining PURPFROM and PURPTO. For example, a trip form work to home would be identified by a code 17.

Field 31. VMODE:

Question 7 on the "Trip Description Page" relates to the person's mode of travel for the trip. Other questions on that form identify whether the person was an autodriver or autopassenger, and whether both auto and transit modes were used during the trip. These responses have been used to create VMODE as follows:

Code	Label	Description
1	Auto Driver	Single mode trips
2	Auto Passenger	
3	Transit	
4	Park and Ride	Combination auto driver and transit passenger
5	Kiss and Ride	Combination auto passenger and transit passenger
6	Bicycle	
7	Walk	
8	Others	
9	Not Specified	

Field 34. OTHERS:

Responses to the "other modes used" section of Question 7 are recorded in this field.

Fields 39, 40, 41, 42, 43:

Responses to Questions A.4 on the "Trip Description Page" are recorded in these fields. PARK-DEST identifies which of the four options of Question A4 was chosen. WALK-TIME contains the respondent's specification, in minutes, of the length of the walk from the parking spot to the final destination. MODE-CHG-MUN contains a two-digit code identifying the municipality in which the person changed modes.

Field 44. PARK-CHARGE

Responses to Question A.5 show that people had difficulty in understanding the question or in properly responding. PARK-CHARGE contains the responses to the question about whether they pay for parking on a per trip, per day etc. basis.

Fields 46, 53:

BUS-MUN and END-BUS-MUN contain two-digit municipality codes indicating, respectively, the municipalities where the bus trip began and ended.

FIGURE D1

Data file : DIARY-HOUSEHOLD
Record size : 131 bytes 1,704 Records

DIARY HOUSEHOLD DATA **Page 1 of 1**

Field Name		Description	Len	Start-End
1	SAMPLE	Diary Sample Number	5	1-5
2	HOME-MUN	Home Municipality	2	6-7
3	NUM-HOUSE	Persons in Household	1	8-8
4	NUM-SIX	Persons under six	1	9-9
5	FULL-TIME	Employed Full-time	1	10-10
6	PART-TIME	Employed Part-time	1	11-11
7	DWELLING-TYPE	Dwelling Unit Type	1	12-12
8	OWN-OR-RENT	Own or Rent	1	13-13
9	NUM-VEH	Number of Vehicles	1	14-14
10	NUM-CYCLE	Number of Motorcycles	1	15-15
11	NUM-DIARY	Number of Diary	1	16-16
12	V1-MODEL	Vehicle 1 Model	8	18-25
13	V1-YEAR	Vehicle 1 Year	2	27-28
14	V1-DIST	Vehicle 1 Distance	5	30-34
15	V1-UNITS	Vehicle 1 Units	1	36-36
16	V1-MONTH	Vehicle 1 Month	2	38-39
17	V2-MODEL	Vehicle 2 Model	8	41-48
18	V2-YEAR	Vehicle 2 Year	2	50-51
19	V2-DIST	Vehicle 2 Distance	5	53-57
20	V2-UNITS	Vehicle 2 Units	1	59-59
21	V2-MONTH	Vehicle 2 Month	2	61-62
22	V3-MODEL	Vehicle 3 Model	8	64-71
23	V3-YEAR	Vehicle 3 Year	2	73-74
24	V3-DIST	Vehicle 3 Distance	5	76-80
25	V3-UNITS	Vehicle 3 Units	1	82-82
26	V3-MONTH	Vehicle 3 Month	2	84-85
27	V4-MODEL	Vehicle 4 Model	8	87-94
28	V4-YEAR	Vehicle 4 Year	2	96-97
29	V4-DIST	Vehicle 4 distance	5	99-103
30	V4-UNITS	Vehicle 4 Units	1	105-105
31	V4-MONTH	Vehicle 4 Month	2	107-108
32	V5-MODEL	Vehicle 5 Model	8	110-117
33	V5-YEAR	Vehicle 5 Year	2	119-120
34	V5-DIST	Vehicle 5 Distance	5	122-126
35	V5-UNITS	Vehicle 5 Units	1	128-128
36	V5-MONTH	Vehicle 5 Month	2	130-131

FIGURE D2

Data file : DIARY-PERSON
Record size : 35 bytes 3,707 Records

DIARY PERSON DATA **Page 1 of 1**

Field Name		**Description**	**Len**	**Start-End**
1	SAMPLE	Diary Sample Number	5	1-5
2	PERSON	Person Number	1	6-6
3	SEX	Sex	1	7-7
4	AGE	Age	1	8-8
5	EMPLOY	Employment Status	1	9-9
6	LICENCE	Driver's Licence	1	10-10
7	DELIVERY	Commercial Courier	1	11-11
8	HANDICAP	Handicapped Transport	1	12-12
9	INDUSTRY	Industry Classification	2	13-14
10	INCOME	Annual Income	1	15-15
11	START	Diary Starting Day	1	16-16
12	DAY1TRIP	# of Trips on Day 1	2	17-18
13	DAY2TRIP	# of Trips on Day 2	2	19-20
14	DAY3TRIP	# of Trips on Day 3	2	21-22
15	ADDRESS	First Origin Address	8	23-30
16	ORI-MUN	First Origin Municipality	2	31-32
17	ADD-TYPE	Address Type	1	33-33
18	HOME-MUN	Home Municipality	2	34-35

FIGURE D3

Data file : DIARY-TRIP
Record size : 187 bytes 37,034 Records

Page 1 of 1

DIARY TRIP DATA

Field	Name	Description	Len	Start-End
1	SAMPLE	Diary Sample Number	5	1-5
2	PERSON	Person Number	1	6-6
3	SURDAY	Survey Day Number	1	7-7
4	TRIPNUM	Trip Number	2	8-9
5	WEEKDAY	Day of the Week	1	10-10
6	HOME-MUN	Home Municipality	2	11-12
7	NUM-HOUSE	No. of Person in Househld	1	13-13
8	NUM-SIX	Persons Under Six	1	14-14
9	FULL-TIME	Employed Full-time	1	15-15
10	PART-TIME	Employed Part-time	1	16-16
11	DWELLING TYPE	Dwelling Unit Type	1	17-17
12	OWN-OR-RENT	Own or Rent	1	18-18
13	NUM-VEH	Number of Vehicle	1	19-19
14	SEX	Sex	1	20-20
15	AGE	Age	1	21-21
16	EMPLOY	Employment Status	1	22-22
17	LICENCE	Driver's Licence	1	23-23
18	DELIVERY	Commercial Courier	1	24-24
19	HANDICAP	Handicapped Transport	1	25-25
20	INDUSTRY	Industry Classification	2	26-27
21	INCOME	Annual Income	1	28-28
22	DEPART	Departure Time	4	29-32
23	ORI-MUN	Origin Municipality	2	33-34
24	DESTIN-ADDRESS	Destination Address	24	35-58
25	DES-MUN	Destination Municipality	2	59-60
26	DEC-ADD-TYPE	Destination Address Type	1	61-61
27	PURP-FROM	Purpose From	1	62-62
28	PURP-TO	Purpose To	1	63-63
29	PURPOSE	Trip Purpose	2	64-65
30	KID-SIX	Kids Under Six	1	66-66
31	VMODE	Mode of Travel	1	67-67
32	AUTO	Auto - All or Part	1	68-68
33	BUS	Transit - All or Part	1	69-69
34	OTHERS	Trip by Other Mode	1	70-70
35	VEHICLE	Vehicle Description	15	71-85
36	YEAR	Vehicle Year	2	86-87
37	DRIVER-PASS	Driver or Passenger	1	88-88
38	CARPOOL	Number in Carpool	2	89-90
39	PARK-DEST	Parking at Destination	1	91-91
40	WALK-TIME	Walking Time	2	92-93
41	PARK-ADDRESS	Parking Address	24	94-117
42	MODE-CHG-MUN	Mode Change Municipality	2	118-119

FIGURE D3

Data file : DIARY-TRIP
Record size : 187 bytes 37,034 Records

DIARY TRIP DATA **Page 1 of 1**

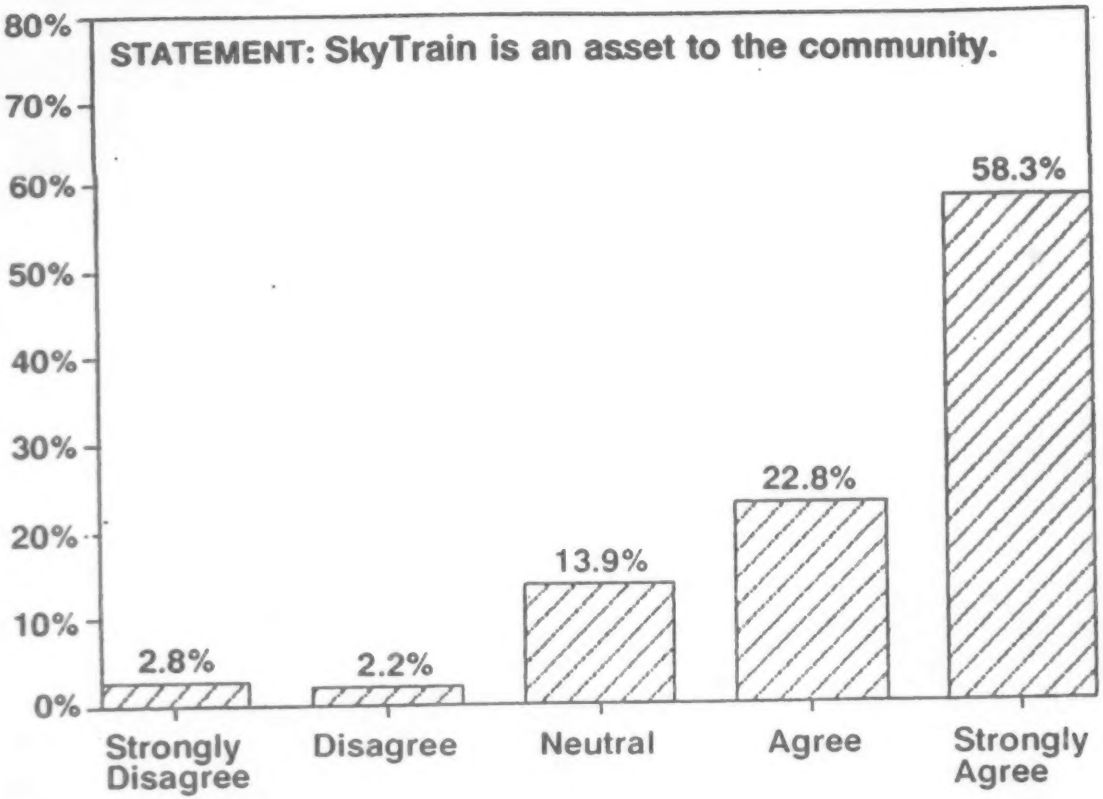
Field Name		Description	Len	Start-End
43	MODE-CHG-ADD-TYPE	Mode Change Add Type	1	120-120
44	PARK-CHARGE	Parking Charge	1	121-121
45	BUS-ADDRESS	Bus Address	24	122-145
46	BUS-MUN	Bus Municipality	2	146-147
47	BUS-ADD-TYPE	Bus Address Type	1	148-148
48	BUS-ACCESS	Transit Access mode	1	149-149
49	BUS-ROUTE1	Bus Route 1	3	150-152
50	BUS-ROUTE2	Bus Route 2	3	153-155
51	BUS-ROUTE3	Bus Route 3	3	156-158
52	END-BUS-ADD	End Bus Address	24	159-182
53	END-BUS-MUN	End Bus Municipality	2	183-184
54	END-BUS-ADD-TYPE	End Bus Address Type	1	185-185
55	BUS-FARE	Transit Fare Type	1	186-186
56	CAR-AVAIL	Car Availability	1	187-187

APPENDIX E

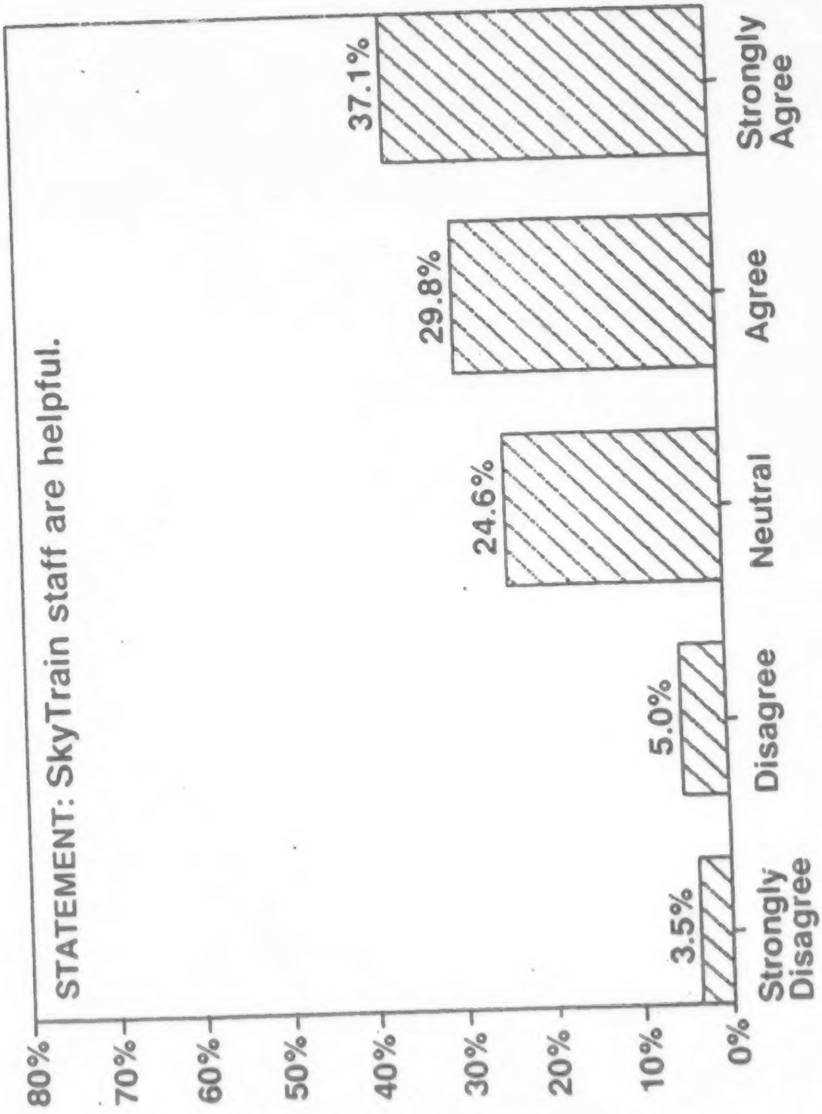
ADDITIONAL DATABASE RESULTS FROM THE SKYTRAIN RIDER SURVEY AND THE SKYTRAIN PARKING INVENTORY

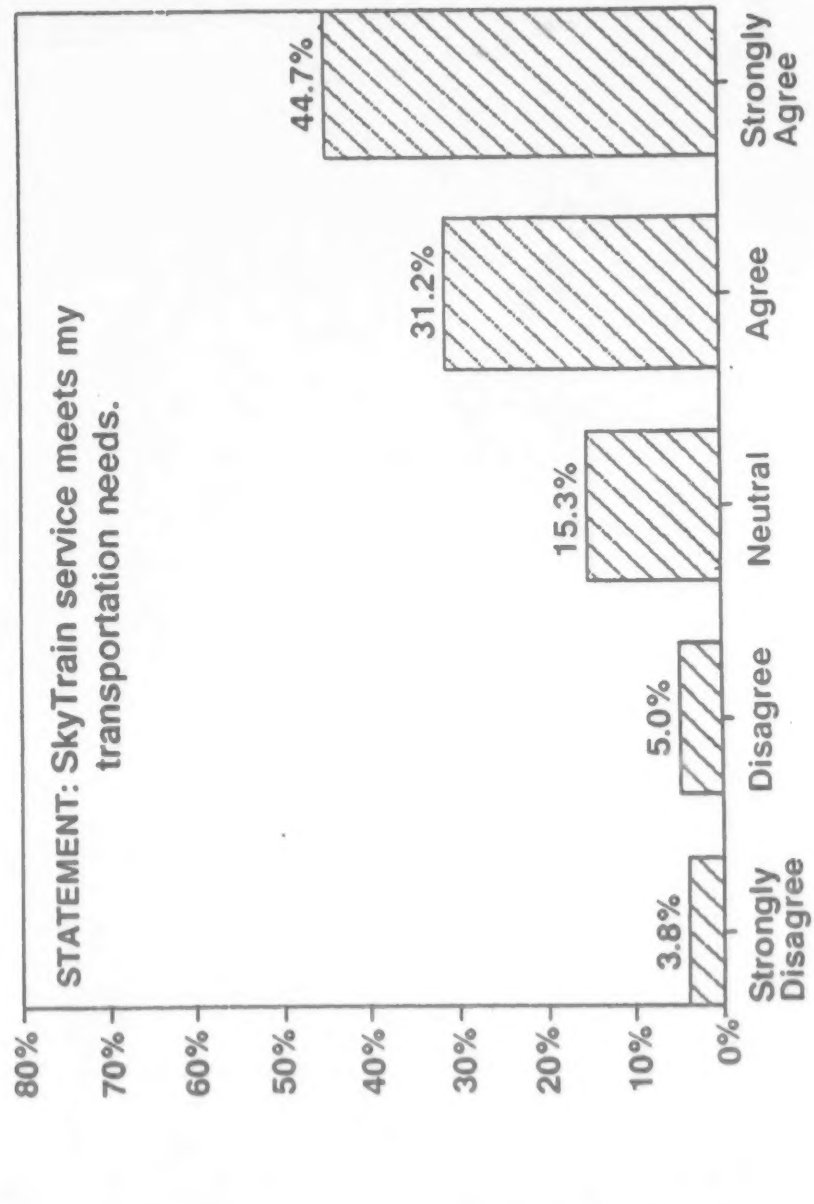
E.1. SKYTRAIN RIDER SURVEY:

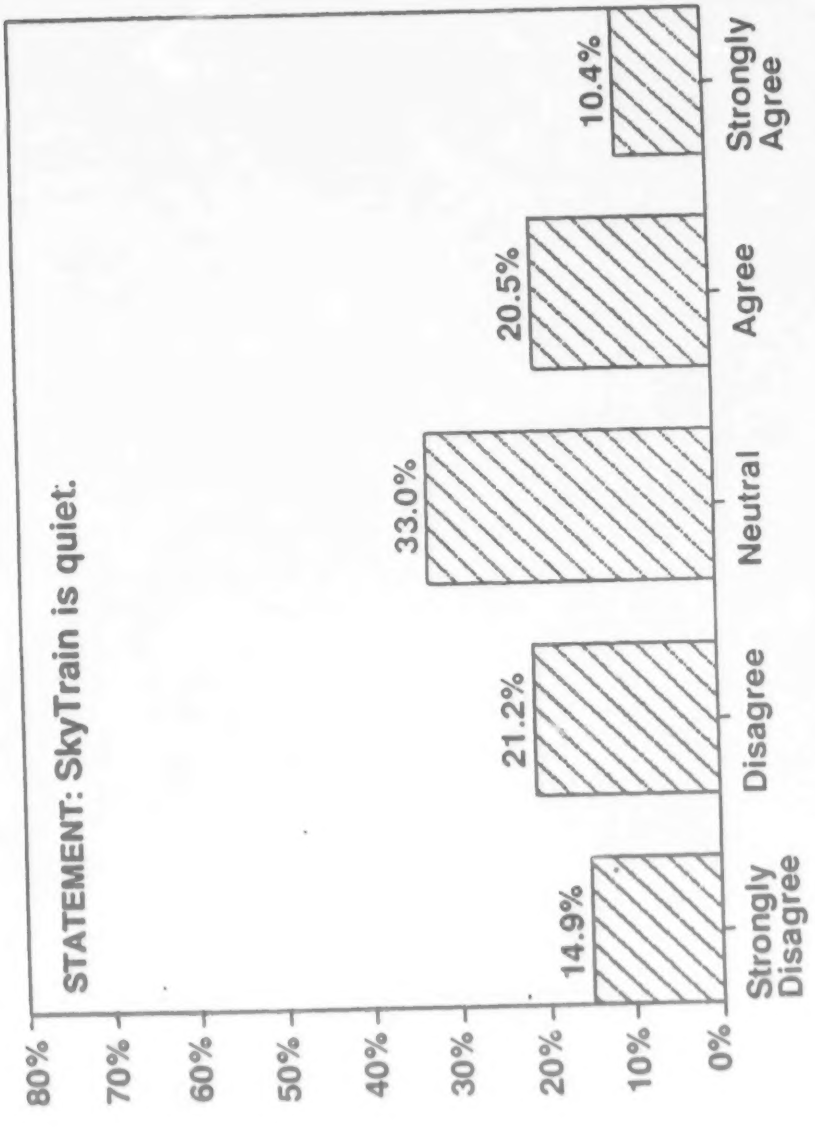
ATTITUDES TO SKYTRAIN



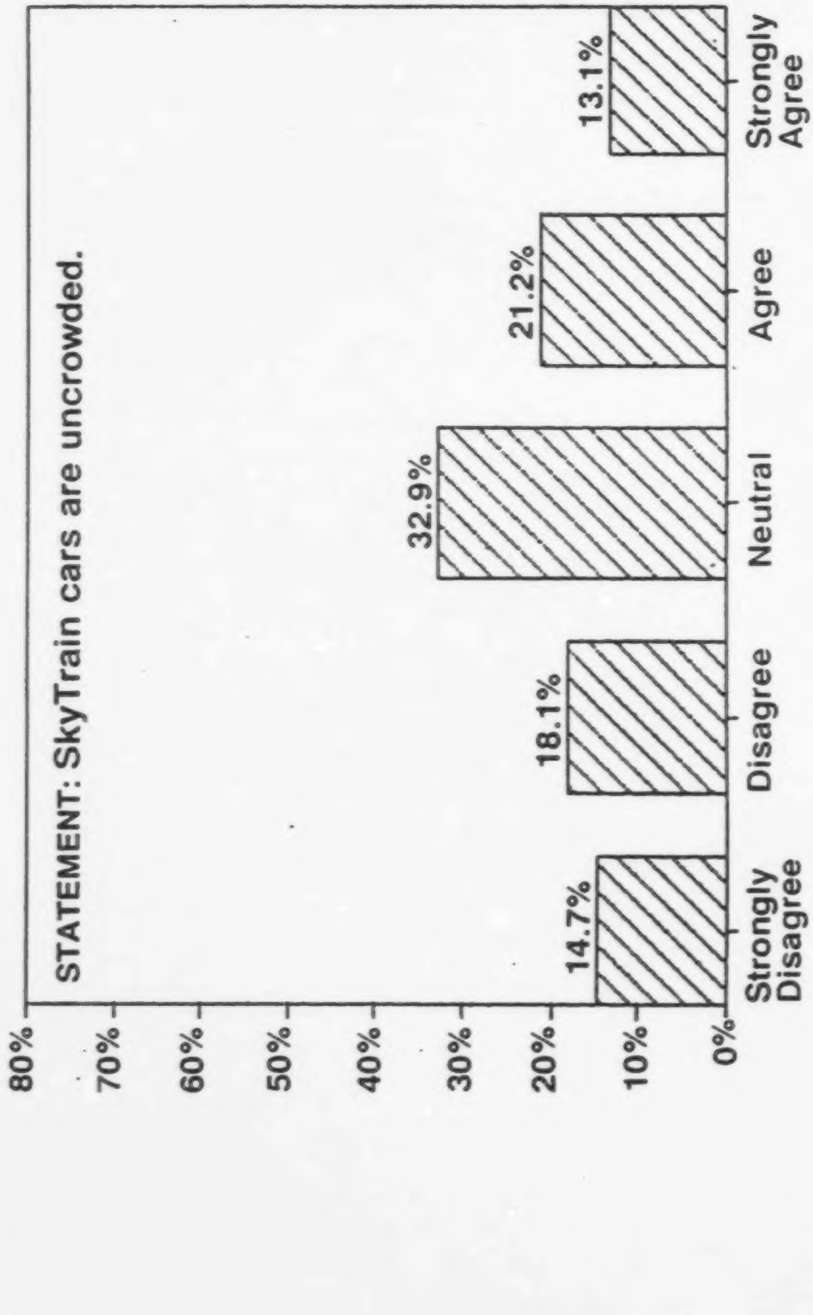
STATEMENT: SkyTrain is an asset to the community.

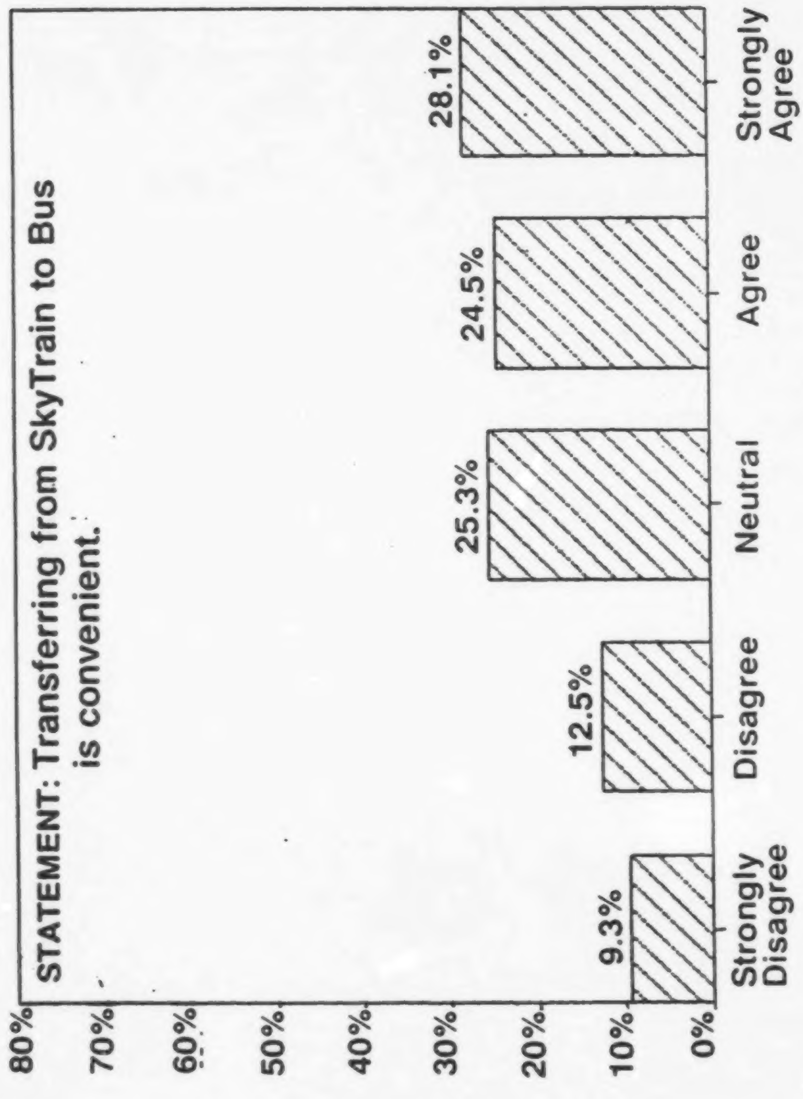

STATEMENT: SkyTrain staff are helpful.
80%
70%
60%
50%
40%
30%
20%
10%
0%
3.5%
5.0%
24.6%
29.8%
37.1%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree

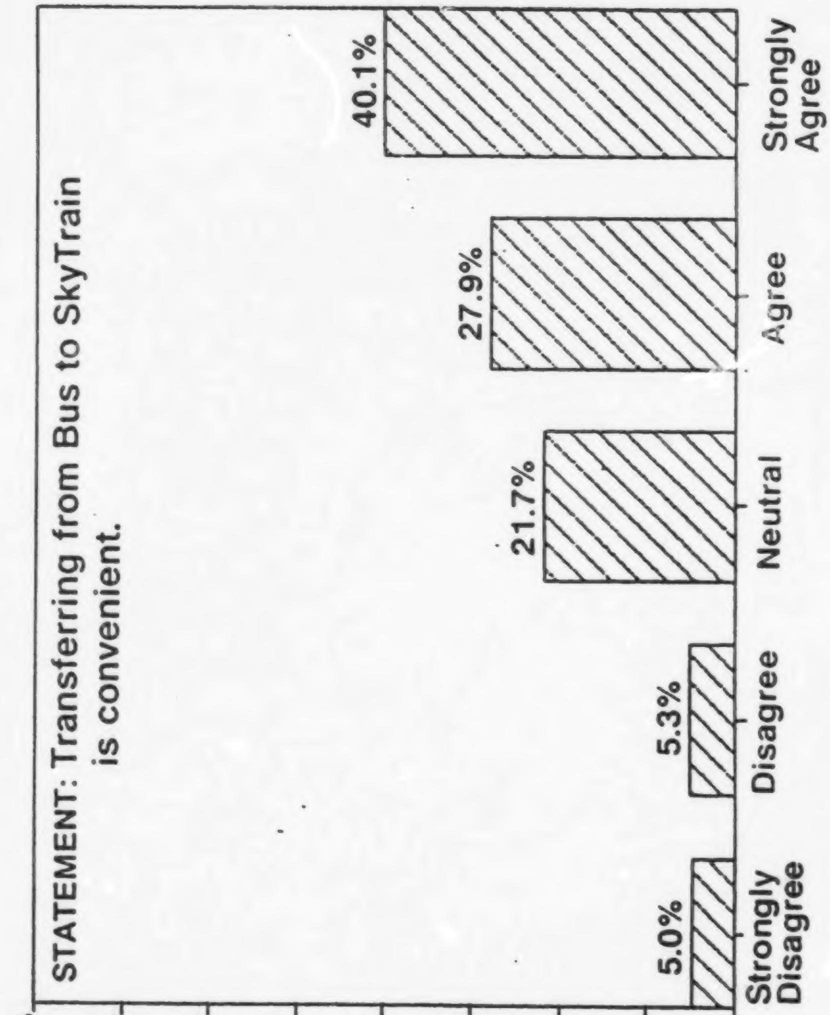

STATEMENT: SkyTrain service meets my transportation needs.
80%
70%
60%
50%
40%
30%
20%
10%
0%
3.8%
5.0%
15.3%
31.2%
44.7%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree

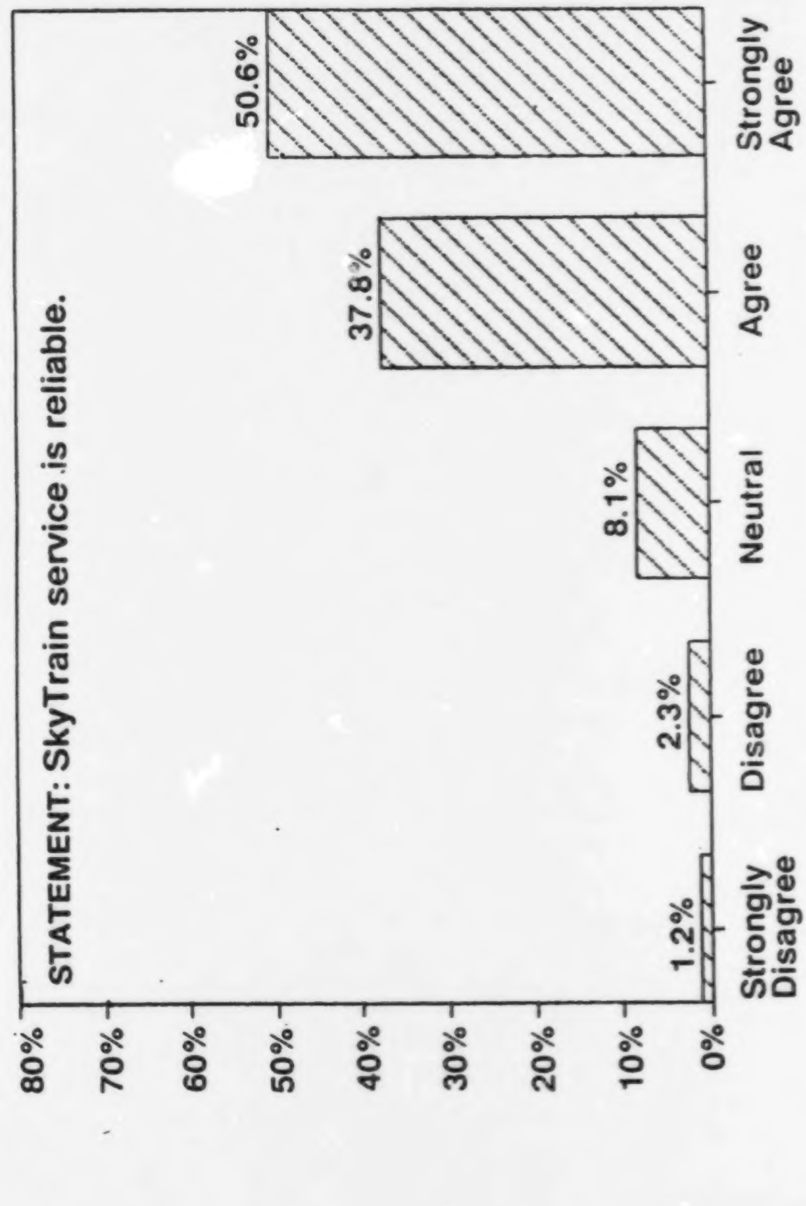


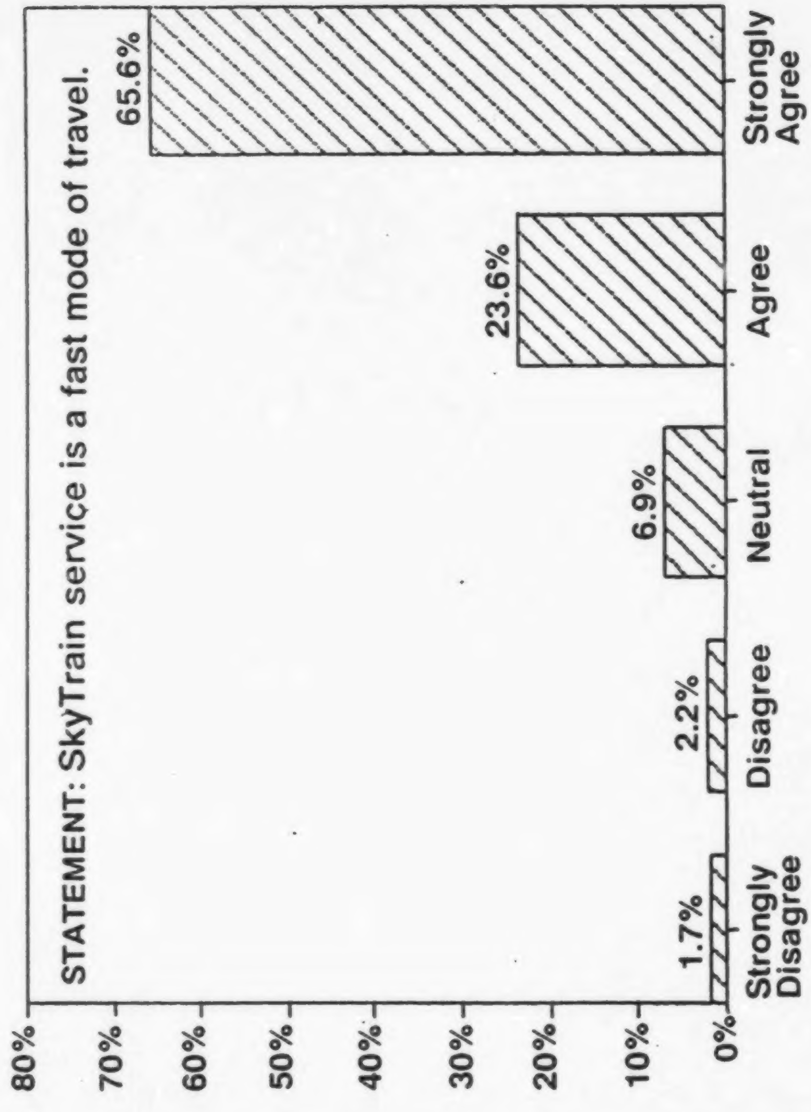
STATEMENT: SkyTrain is quiet.

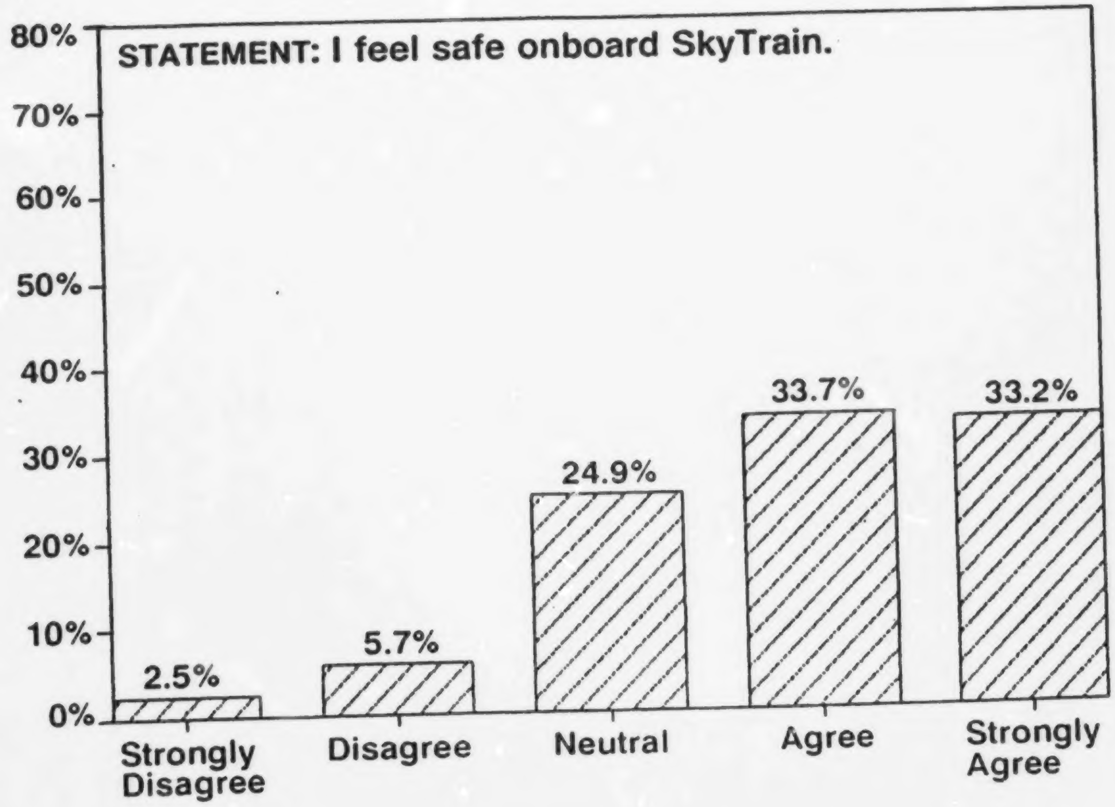

STATEMENT: SkyTrain cars are uncrowded.
80%
70%
60%
50%
40%
30%
20%
10%
0%
14.7%
18.1%
32.9%
21.2%
13.1%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


STATEMENT: Transferring from SkyTrain to Bus is convenient.
80%
70%
60%
50%
40%
30%
20%
10%
0%
9.3%
12.5%
25.3%
24.5%
28.1%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


STATEMENT: Transferring from Bus to SkyTrain is convenient.
80%
70%
60%
50%
40%
30%
20%
10%
0%
5.0%
5.3%
21.7%
27.9%
40.1%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


STATEMENT: SkyTrain service is reliable.
80%
70%
60%
50%
40%
30%
20%
10%
0%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree
1.2%
2.3%
8.1%
37.8%
50.6%


STATEMENT: SkyTrain service is a fast mode of travel.
80%
70%
60%
50%
40%
30%
20%
10%
0%
1.7%
2.2%
6.9%
23.6%
65.6%
Strongly Disagree
Disagree
Neutral
Agree
Strongly Agree


STATEMENT: I feel safe onboard SkyTrain.

E.2. SKYTRAIN PARKING INVENTORY:
DATABASE SUMMARIES

Available Parking Spaces - Summary Report

STATION	ZONE	PARKING TYPE ON	OFF	PARKING DURATION RESIDENT	EMPLOYEE	TRANSIENT	PARKING CHARGE FREE	METERED	TICKET	PARKING SPACES TOTAL	PERCENT	PARKING SPACES CUMULATIVE	PERCENT
METROTOWN	0-100 metres	45	230	45	80	150	125	0	150	275	4.3	275	4.3
	101-200 metres	21	205	45	160	21	226	0	0	226	3.5	501	7.9
	201-300 metres	476	609	687	365	33	1085	0	0	1085	17.1	1586	25.1
	301-400 metres	765	1121	693	125	1068	1816	0	70	1886	29.8	3472	55.0
	401-500 metres	377	977	630	343	381	1336	0	18	1354	21.4	4826	76.4
	501-600 metres	370	996	335	75	956	1366	0	0	1366	21.6	6192	98.1
	601-700 metres	50	67	95	0	22	117	0	0	117	1.8	6309	100.0
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		2104	4205	2530	1148	2631	6071	0	238	6309			
ROYAL OAK	101-200 metres	342	323	367	227	71	665	0	0	665	10.4	665	10.4
	201-300 metres	1106	62	1065	40	63	1168	0	0	1168	18.3	1833	28.7
	301-400 metres	745	214	598	0	361	959	0	0	959	15.0	2792	43.7
	401-500 metres	2019	219	1221	0	1017	2238	0	0	2238	35.0	5030	78.8
	501-600 metres	530	588	568	0	550	1118	0	0	1118	17.5	6148	96.3
	601-700 metres	108	123	180	0	51	231	0	0	231	3.6	6379	100.0
		=========	=========	=========	=========	=========	=========	=========	=========	==========			
		4850	1529	3999	267	2113	6379	0	0	6379			
22ND AVENUE	0-100 metres	123	20	123	0	20	143	0	0	143	4.0	143	4.0
	101-200 metres	506	100	606	0	0	606	0	0	606	16.9	749	20.9
	201-300 metres	635	106	635	56	50	741	0	0	741	20.7	1490	41.7
	301-400 metres	709	198	815	92	0	907	0	0	907	25.4	2397	67.1
	401-500 metres	552	119	671	0	0	671	0	0	671	18.8	3068	85.9
	501-600 metres	380	89	469	0	0	469	0	0	469	13.1	3537	99.1
	601-700 metres	31	0	31	0	0	31	0	0	31	0.8	3568	100.0
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		2936	632	3350	148	70	3568	0	0	3568			
NEW WESTMINSTER	0-100 metres	20	6	0	0	26	6	20	0	26	0.4	26	0.4
	101-200 metres	255	429	4	351	329	493	37	154	684	10.6	710	11.0
	201-300 metres	301	1529	0	822	1008	348	145	1337	1830	28.3	2540	39.4
	301-400 metres	615	403	166	145	707	750	130	138	1018	15.7	3558	55.2
	401-500 metres	691	719	356	288	766	1320	49	41	1410	21.8	4968	77.0
	501-600 metres	404	656	348	251	461	818	82	160	1060	16.4	6028	93.5
	601-700 metres	71	345	201	90	45	416	0	0	416	6.4	6444	100.0
		=========	=========	=========	=========	=========	=========	=========	=========	==========			
		2357	4087	1155	1947	3342	4151	463	1830	6444			

Available Parking Spaces - Summary Report

STATION	ZONE	PARKING TYPE ON	OFF	PARKING DURATION RESIDENT	EMPLOYEE	TRANSIENT	PARKING CHARGE FREE	METERED	TICKET	PARKING SPACES TOTAL	PERCENT	PARKING SPACES CUMULATIVE	PERCENT
BROADWAY	0-100 metres	224	68	0	0	292	257	0	35	292	4.8	292	4.8
	101-200 metres	439	578	266	0	751	690	113	214	1017	16.9	1309	21.8
	201-300 metres	571	740	816	0	495	1311	0	0	1311	21.8	2620	43.6
	301-400 metres	367	546	636	60	217	913	0	0	913	15.2	3533	58.9
	401-500 metres	1195	713	1784	0	124	1908	0	0	1908	31.8	5441	90.7
	501-600 metres	329	219	480	24	44	548	0	0	548	9.1	5989	99.8
	601-700 metres	9	0	9	0	0	9	0	0	9	0.1	5998	100.0
		3134	2864	3991	84	1923	5636	113	249	5998			
NANAIMO	0-100 metres	0	8	8	0	0	8	0	0	8	0.1	8	0.1
	101-200 metres	332	73	405	0	0	405	0	0	405	8.1	413	8.3
	201-300 metres	806	523	1329	0	0	1329	0	0	1329	26.8	1742	35.2
	301-400 metres	892	485	1377	0	0	1377	0	0	1377	27.8	3119	63.0
	401-500 metres	627	490	1012	105	0	1117	0	0	1117	22.5	4236	85.6
	501-600 metres	434	228	662	0	0	662	0	0	662	13.3	4898	99.0
	601-700 metres	45	0	45	0	0	45	0	0	45	0.9	4943	100.0
		3136	1807	4838	105	0	4943	0	0	4943			
29TH AVENUE	0-100 metres	249	0	249	0	0	249	0	0	249	5.5	249	5.5
	101-200 metres	217	114	331	0	0	331	0	0	331	7.4	580	12.9
	201-300 metres	264	190	454	0	0	454	0	0	454	10.1	1034	23.1
	301-400 metres	1009	490	1471	28	0	1499	0	0	1499	33.5	2533	56.7
	401-500 metres	992	339	1331	0	0	1331	0	0	1331	29.8	3864	86.5
	501-600 metres	290	245	517	0	18	535	0	0	535	11.9	4399	98.4
	601-700 metres	67	0	67	0	0	67	0	0	67	1.5	4466	100.0
		3088	1378	4420	28	18	4466	0	0	4466			
JOYCE	101-200 metres	267	297	484	20	60	564	0	0	564	9.7	564	9.7
	201-300 metres	465	6	465	6	0	471	0	0	471	8.1	1035	17.9
	301-400 metres	1101	555	1644	12	0	1656	0	0	1656	28.6	2691	46.5
	401-500 metres	939	371	1240	45	25	1310	0	0	1310	22.6	4001	69.2
	501-600 metres	875	577	1131	87	234	1452	0	0	1452	25.1	5453	94.3
	601-700 metres	233	95	281	0	47	328	0	0	328	5.6	5781	100.0
		3880	1901	5245	170	366	5781	0	0	5781			
PATTERSON	0-100 metres	18	0	18	0	0	18	0	0	18	0.4	18	0.4
	101-200 metres	150	246	317	0	79	396	0	0	396	10.4	414	10.9
	201-300 metres	180	326	345	46	115	460	0	46	506	13.3	920	24.2
	301-400 metres	667	591	530	440	288	883	375	0	1258	33.1	2178	57.3
	401-500 metres	228	285	108	15	390	513	0	0	513	13.5	2691	70.8
	501-600 metres	446	617	196	100	767	1063	0	0	1063	27.9	3754	98.8
	601-700 metres	26	18	44	0	0	44	0	0	44	1.1	3798	100.0
		1715	2083	1558	601	1639	3377	375	46	3798			

Parking Utilization - Summary Report

			UTILISED PARKING				UTILISATION RATES			
STATION	ZONE	AVAILABLE PARKING	PRE- SKYTRAIN	POST- SKYTRAIN	POST- BUS LINK	POST- EXPO 86	PRE- SKYTRAIN	POST- SKYTRAIN	POST- BUS LINK	POST- EXPO 86
BROADWAY	0-100 metres	292	46	52	0	0	15.7	17.8	0.0	0.0
	101-200 metres	1017	351	402	0	0	34.5	39.5	0.0	0.0
	201-300 metres	1311	451	494	0	0	34.4	37.6	0.0	0.0
	301-400 metres	913	338	357	0	0	37.0	39.1	0.0	0.0
	401-500 metres	1908	546	637	0	0	28.6	33.3	0.0	0.0
	501-600 metres	548	157	187	0	0	28.6	34.1	0.0	0.0
	601-700 metres	9	0	0	0	0	0.0	0.0	0.0	0.0
		=========	=========	=========	=========	=========	=========	=========	=========	=========
		5998	1889	2129	0	0	31.4	35.4	0.0	0.0
NANAIMO	0-100 metres	8	2	0	0	0	25.0	0.0	0.0	0.0
	101-200 metres	405	94	0	0	0	23.2	0.0	0.0	0.0
	201-300 metres	1329	346	0	0	0	26.0	0.0	0.0	0.0
	301-400 metres	1377	320	0	0	0	23.2	0.0	0.0	0.0
	401-500 metres	1117	300	0	0	0	26.8	0.0	0.0	0.0
	501-600 metres	662	174	0	0	0	26.2	0.0	0.0	0.0
	601-700 metres	45	1	0	0	0	2.2	0.0	0.0	0.0
		=========	=========	=========	=========	=========	=========	=========	=========	=========
		4943	1237	0	0	0	25.0	0.0	0.0	0.0
29TH AVENUE	0-100 metres	249	28	0	0	0	11.2	0.0	0.0	0.0
	101-200 metres	331	73	0	0	0	22.0	0.0	0.0	0.0
	201-300 metres	454	128	0	0	0	28.1	0.0	0.0	0.0
	301-400 metres	1499	334	0	0	0	22.2	0.0	0.0	0.0
	401-500 metres	1331	295	0	0	0	22.1	0.0	0.0	0.0
	501-600 metres	535	155	0	0	0	28.9	0.0	0.0	0.0
	601-700 metres	67	5	0	0	0	7.4	0.0	0.0	0.0
		=========	=========	=========	=========	=========	=========	=========	=========	=========
		4466	1018	0	0	0	22.7	0.0	0.0	0.0
JOYCE	101-200 metres	564	135	0	0	0	23.9	0.0	0.0	0.0
	201-300 metres	471	81	0	0	0	17.1	0.0	0.0	0.0
	301-400 metres	1656	407	0	0	0	24.5	0.0	0.0	0.0
	401-500 metres	1310	342	0	0	0	26.1	0.0	0.0	0.0
	501-600 metres	1452	445	0	0	0	30.6	0.0	0.0	0.0
	601-700 metres	328	146	0	0	0	44.5	0.0	0.0	0.0
		=========	=========	=========	=========	=========	=========	=========	=========	=========
		5781	1556	0	0	0	26.9	0.0	0.0	0.0
PATTERSON	0-100 metres	18	15	0	0	0	83.3	0.0	0.0	0.0
	101-200 metres	396	109	0	0	0	27.5	0.0	0.0	0.0
	201-300 metres	506	152	0	0	0	30.0	0.0	0.0	0.0
	301-400 metres	1258	591	0	0	0	46.9	0.0	0.0	0.0
	401-500 metres	513	203	0	0	0	39.5	0.0	0.0	0.0
	501-600 metres	1063	459	0	0	0	43.1	0.0	0.0	0.0
	601-700 metres	44	8	0	0	0	18.1	0.0	0.0	0.0
		=========	=========	=========	=========	=========	=========	=========	=========	=========
		3798	1537	0	0	0	40.4	0.0	0.0	0.0

Parking Utilization - Summary Report

STATION	ZONE	AVAILABLE PARKING	UTILISED PARKING				UTILISATION RATES			
			PRE-SKYTRAIN	POST-SKYTRAIN	POST-BUS LINK	POST-EXPO 86	PRE-SKYTRAIN	POST-SKYTRAIN	POST-BUS LINK	POST-EXPO 86
METROTOWN	0-100 metres	275	16	17	0	0	5.8	6.1	0.0	0.0
	101-200 metres	226	92	185	0	0	40.7	81.8	0.0	0.0
	201-300 metres	1085	514	396	0	0	47.3	36.4	0.0	0.0
	301-400 metres	1886	722	1048	0	0	38.2	55.5	0.0	0.0
	401-500 metres	1354	410	482	0	0	30.2	35.5	0.0	0.0
	501-600 metres	1366	631	561	0	0	46.1	41.0	0.0	0.0
	601-700 metres	117	50	52	0	0	42.7	44.4	0.0	0.0
		6309	2435	2741	0	0	38.5	43.4	0.0	0.0
RO[illegible] OAK	101-200 metres	665	362	0	0	0	54.4	0.0	0.0	0.0
	201-300 metres	1168	393	0	0	0	33.6	0.0	0.0	0.0
	301-400 metres	959	254	0	0	0	26.4	0.0	0.0	0.0
	401-500 metres	2238	650	0	0	0	29.0	0.0	0.0	0.0
	501-600 metres	1118	325	0	0	0	29.0	0.0	0.0	0.0
	601-700 metres	231	90	0	0	0	38.9	0.0	0.0	0.0
		6379	2074	0	0	0	32.5	0.0	0.0	0.0
22ND AVENUE	0-100 metres	143	22	33	0	0	15.3	23.0	0.0	0.0
	101-200 metres	606	105	118	0	0	17.3	19.4	0.0	0.0
	201-300 metres	741	184	178	0	0	24.8	24.0	0.0	0.0
	301-400 metres	907	144	191	0	0	15.8	21.0	0.0	0.0
	401-500 metres	671	113	135	0	0	16.8	20.1	0.0	0.0
	501-600 metres	469	74	88	0	0	15.7	18.7	0.0	0.0
	601-700 metres	31	3	2	0	0	9.6	6.4	0.0	0.0
		3568	645	745	0	0	18.0	20.8	0.0	0.0
NEW WESTMINSTER	0-100 metres	26	18	0	0	0	69.2	0.0	0.0	0.0
	101-200 metres	684	297	0	0	0	43.4	0.0	0.0	0.0
	201-300 metres	1830	1391	0	0	0	76.0	0.0	0.0	0.0
	301-400 metres	1018	529	0	0	0	51.9	0.0	0.0	0.0
	401-500 metres	1410	661	0	0	0	46.8	0.0	0.0	0.0
	501-600 metres	1060	388	0	0	0	36.6	0.0	0.0	0.0
	601-700 metres	416	210	0	0	0	50.4	0.0	0.0	0.0
		6444	3494	0	0	0	54.2	0.0	0.0	0.0

APPENDIX F

AUTOMATED PROCEDURES USED IN THE TELEPHONE SURVEY

AUTOMATED PROCEDURES USED IN THE TELEPHONE SURVEY

1. OVERVIEW

There are relatively few instances in recent years of comprehensive travel surveys being undertaken in Canadian cities. Compared with earlier surveys, more recent surveys have had a greater opportunity to take advantage of computerized procedures in their execution, in the coding, editing and factoring of data, and in the presentation of results. Accordingly, while the various applications of automated procedures in the Greater Vancouver survey were not particularly novel or unprecedented, it is perhaps useful to summarize them as a potential guide to other interested parties.

2. SURVEY PREPARATION AND EXECUTION

2.1 Drawing a Sample

Utilities - telephone, power, water - generally have the most complete coverage in a metropolitan area of households and businesses. Utilities usually distinguish households from other clients (e.g., by rate structure), and usually have up-to-date and automated client lists. For the Greater Vancouver survey, B.C. Tel was able to provide files from their August 1985 billing records containing the names, addresses and phone numbers of households with listed telephone numbers in each of their three-digit exchange areas. They also identified the total number of unlisted numbers in each exchange and vetted the file of listed telephones to attempt to identify instances of two or more telephone numbers in any one household. GVRD staff specified a crude sampling rate for each exchange area - every nth record to be picked from each area's file - to achieve the survey sample for both the telephone interview and trip diary components. The selected records were randomized by B.C. Tel and each record in the randomized file was assigned a sequential survey code number.

2.2 Printing Contact Letters and Survey Forms

Pre-interview contact letters were to be sent to each household in the sample. The bodies of these letters, without addresses, were printed on high quality, continuous form bond paper. By linking the master survey file to a high-quality printer, bundles of contact letters could be prepared, with the name and address of each household being typed automatically on the letter body so that, after folding, the address would show through when inserted into a window envelope. Each week, timed so that letters would arrive a few days before interviewing, bundles of completed letters were sent to a printer where there was equipment to burst the continuous forms, fold the letters and stuff the envelopes, and pass the letters through a postage meter.

3. DATA EDITING AND GEO-CODING

3.1 Initial Range and Validity Checks

Completed survey coding forms were subject to manual editing at the survey site prior to being sent on for keypunching. Verification procedures were conducted at the keypunch site. Files of keypunched survey data were then subject to various automated validation procedures at GVRD.

One of the more important inspections, considering the key system used to uniquely identify each household and trip segment record, was to ensure that there were no duplicate keys in the data. Missing data checks ensured that each field that should have a specification did indeed have one. Range checks ensured that there was an acceptable specification. Format checks were similar to range checks. (A specific format check can be mentioned. Trip ends at intersections were to be identified by a special one-digit trip end code; in the text field, the names of the two streets that intersect were to be separated by a slash (/). The format check ensured that all trip ends that were identified as intersections had a slash, and that no slash appeared in the text field of trip ends that were not intersections.) Consistency checks ensured, for example, that there was a match between the specified number of persons, the total number of persons for whom age and sex data were provided and the total number of persons for whom trip data was provided.

Records failing on one or more of the checks were listed by their key number, along with the code or message identifying the problem.

3.2 Geo-coding

The overall intention of the geo-coding process was to identify the Universal Transverse Mercator coordinates of the origin and destination of each trip segment and then to locate each segment within one of the 350 traffic zones of the GVRD's system.

For the origin of each person's first trip segment and for the destination of that segment and every ensuing trip or trip segment, the interviewer was obliged to enter the municipality code, the trip end "ID code" and a text description of the trip end. A procedure had been established to patch the specification of a destination into the corresponding fields for the origin of the following trip or trip segment of that person. As is noted elsewhere, there were four categories of trip end ID: specific street addresses; intersections; monuments (i.e. specific place names); and "other", being situations when the interviewee could not make a precise specification (e.g. "Downtown" or "Unknown").

Incoming files of trip data were first subjected to the validity checks. Then, four sub-files were created, one for each of the trip end ID-types. Each sub-file was sorted by municipality code and by alphabet using the text field. Each record of this sorted file was then compared with a sorted master file for that ID type. If no match could be found, the "new" trip-end description was added automatically to the master file. If a match could be found, the UTM's from the master file record would be patched into the appropriate fields in the trip record. It was the task of the geo-coding clerk, working with the master file, to identify and enter the UTM coordinates of each of distinct trip end specification. (This procedure made use of a digitizing tablet.) Periodic reruns of the match routine were made to catch recent additions to the UTM's of the master file. Then, using "point in polygon" search routines, the trip end UTM's were compared against digitized boundaries of the traffic zone system, the appropriate zone number being added to the trip record.

Special procedures to handle trip ends at intersections should be mentioned. First, coding conventions were established so that only two-letter street categories were used (i.e. ST, RD, CR, HI, etc.). These descriptions could then be automatically be "stripped" from the text field. (Otherwise, the computer would not match Brown St with Brown Street. Nothing could be done, however, with spelling variations, each different version becoming a new entry in the master file.) Second, as noted above, the names of the streets of the intersection were obliged to be separated in the text field by a slash. In the matching procedure, the comparison could be made against both Apple/Brown and Brown/Apple specifications. Third, as is described in the report, random offsets were applied to the UTM's of trip ends at intersections; this ensured that all trip ends were not located in one traffic zone as might otherwise occur when two or more traffic zones meet at an intersection.

Trip ends at the home location - about 40% of the total - were identified in the trip record by the symbol "H" in the text field. The UTM's of the household locations were entered into the file of household-related data. Then, by comparing the household file with the trip file on the basis of their record key - the household key number being an element of the trip record key - the UTM's of the household location could be automatically patched into the appropriate fields in the trip record.

3.3 Final Editing and Data Base Preparation

"Select and sort" procedures are common utilities of data base management packages. These procedures could be used to identify records with errors and missing or inconsistent data. Computer programs were also written to perform mass edits, for example, to convert specifications into new categories or to create new fields. After final editing, the files were stripped of "overhead" data (the name, address and telephone number of the household, the UTM's and text fields related to trip ends, etc); the file of trip records, for example, was compressed from 72,000 to 17,000 data blocks, a block being 512 bytes. A companion report describes the format and features of the data bases derived from the telephone survey.

4. ON THE ISSUES OF AUTOMATED DATA ENTRY AND AUTOMATED GEO-CODING

4.1 Overview

In his report, "Feasibility Study and Work Program", Prof, Steuart outlined possible procedures for automating and combining the data entry and geo-coding procedures. Prof. Steuart's report also presents considerations relevant to the choices between using stand-alone microcomputers versus peripherals linked to a central computer and between using batch versus on-line data editing and geo-coding.) As is noted in the body of this report, time constraints dictated that the "tried and true" method using paper coding forms was used in the Greater Vancouver telephone survey. Such constraints may not apply in other areas where travel surveys are being considered. What follows is a summary of some of the issues that are germane to the choice between "on paper" versus "on screen" data entry, and to the choice as to whether or not to link automated data entry procedures with automated geo-coding procedures.

4.2 Summary of the Issues

(a) Manual methods are reliable and worker-paced: the procedures are simple and understandable.

(b) Automated data entry procedures can better ensure completeness and validity of data. Time and effort can be saved through such procedures as automated dialing, "bring forwards for return calls", and automated geo-coding of trip end specifications. No subsequent keypunching is required.

4.2.2 From the Interviewer's Point of View

(a) Do skilled interviewers also have necessary keyboard skills? What (extra) training will be necessary? Will extra skills be reflected in higher wage/salary costs?

(b) "Automated" interviewers have to respond to two stimuli: from the screen/computer and from the interviewee. Tension and eyestrain may be problems. How will these affect completion rates per hour, hours of interviewing and interviewer turnover?

(c) How easy can it be made for interviewers to "flip" to other screens or fields to add new data or correct the earlier specifications? Extensive pre-design testing is required to identify the myriad "twist and turns" that can arise during an interview and then to build in the ability to cope with these exceptional circumstances.

4.2.3 How Necessary and Feasible is Direct Geo-coding?

(a) Some cities may have computerized files identifying the locations of intersections and monuments according to some spatial reference system. For most cities, however, street addresses (linked to block faces in an Area Master File or to Postal Codes) are the only basis for automated geo-coding using on-line look-up files.

(b) How complete/thorough and error-free is your city's AMF or postal code file? It may be more effort to vett and complete your AMF than it will be to establish and execute procedures to deal with the data that is actually collected.

(c) Unless lookup files of intersections and monuments are to be created for other purposes, one would not "pre-geo-code" prior to the start of the survey. In this way, only named places and intersections would be geo-coded. (Similarly, in Greater Vancouver, geo-coding of household addresses awaited the completion of data collection so that only responding households had to be geo-coded rather than the whole sample file.)

(d) In Greater Vancouver, 40% of the approximately 355,000 trip segment ends were the home location, requiring that 25,000 household locations be geo-coded. Also, about 5% of trip ends were specific street addresses; on the order of 5,000 different addresses were geo-coded. The GVRD had no look-up file of intersection locations and only 1,500 geo-coded monuments, such that it was necessary to geo-code approximately 11,500 intersections and 15,000 monuments. (Trip ends of the "other" category, - perhaps 2,500 different specifications in all - generally are not amenable to precise geo-coding.) All categories considered, about half the trip end specifications could have been immediately associated with a street address. Hence, only about half of the trip ends would have been instantly and automatically geo- codable were a reliable AMF file available for Greater Vancouver. In terms of geo-coding effort, street addresses and intersections are more easily geo-coded than monuments which in turn are more easily geo-coded than "others".

(e) A great deal of the complexity of the design and actual use of on-screen data entry relates to the arrangements that are required to do direct geo-coding. By contrast, the design of "range and completeness" checks for on-screen entry - undoubtedly an advantage over on-paper entry methods - are relatively simple to establish.

4.2.4 Cost Differentials

(a) Wage rates and training costs for interviewers without keyboard skills are likely to be lower than for interviewers with both skills, but a (larger) editing staff is needed to inspect completed paper coding forms. One could only speculate on productivity and turnover differences between methods.

(b) Thorough pretesting of the interview script and procedure is a prerequisite to both the design of a paper coding form and to the design of on-screen data entry procedures. Development costs for the automated procedures will likely be significant.

(c) On the one hand, there are the costs of renting the computers or terminals and "wiring" the interview room. (Rental costs depend on volume and duration. Twenty-four Macintosh computers on a three-month lease cost about $200 each per month, meaning that rental costs for the Greater Vancouver survey would have been about $15,000.) On the other hand, there are the costs of printing paper coding forms and keypunching the data, about $25,000 for the Greater Vancouver survey.

(d) Even if there are comprehensive AMF files and look-up files for the locations of intersections and monuments, extensive "manual" geo-coding will still be required. Hence, many of the fixed costs (equipment, space, staff training, etc.) of manual geo-coding can not be avoided. Direct geo-coding procedures linked to data entry may reduce the variable costs of geo-coding. Overall, it may be more advantageous to separate data entry from geo-coding entirely to make both processes more simple and efficient.